#### ARCHIVES OF OTOLOGY.

CASE OF CEREBELLAR ABSCESS, DUE TO EAR-DISEASE, SUCCESSFULLY OPERATED UPON.

By Dr. WM. MACEWEN, GLASGOW.1

CASE has recently occurred at the Royal Infirmary here, in which, for the first time in the records of surgery, an abscess in the cerebellum has been reached by perforating the occipital bone and tapping the abscess with success. The patient was a young man of seventeen years of age, who had suffered for twelve years from purulent disease of the left middle ear. He was sent into Dr. Macewen's wards in an apparently moribund condition; he was unconscious, had an extremely weak and slow pulse, while his respirations numbered only ten per second. There was marked optic neuritis. No history could be obtained, as the friends left the hospital immediately after depositing the patient inside. The disease of the ear was detected, and a sinus was seen to exist behind the auricle. Dr. Macewen perforated, by means of a burr propelled by a dental engine, the cortex of the mastoid, opened into the antrum, and cleared out caseous-looking matter. He then exposed the lateral sinus, on which he found granulation tissue. With the same burr, Dr. Macewen then perforated the bone farther back than the groove for the lateral sinus, and on reaching and cutting through the membranes over the cerebellum, a quantity of pus escaped with considerable force through the opening. Altogether about four ounces of pus were liberated from the interior of the cerebellum. A decalcified chicken-bone drainage-tube was inserted, and antiseptic dressings applied. No anæsthetic was adminis-Immediate improvement in the condition of the

<sup>&</sup>lt;sup>1</sup> Note by Dr. Thomas Barr, Glasgow.

patient took place. The pulse and respiration increased in strength and rapidity, while consciousness returned. A month has elapsed since the operation, and the patient has made an excellent recovery. The dressings have only been renewed once, and that a fortnight after the operation, when the wound was nearly healed. After the operation, it was elicited that the symptoms observed before the man's admission to the infirmary were vomiting, great pain in the head, severe and frequent rigors and hemiplegia of the left side, the same side as the ear affected. Further details will ultimately be published.

# LOSS OF MEMBRANA TYMPANI, MALLEUS, IN CUS, AND STAPES, WITH GOOD HEARING.

By C. F. CLARK, M.D., COLUMBUS, O.

THE following case, aside from the curious demonstration which it supplies of the possibility of good hearing without the ossicles and membrana tympani, presents several points of interest in its clinical history, to which I would call attention.

Miss Katie F., a school-girl, aged fourteen, was brought to me on August 8, 1888, with a large, deep, sloughing ulcer of the lower cul-de-sac of each eye. These ulcers presented a deep, punched out appearance, with a slough separating in the centre, a reddish, inclining to a blackish base, especially on the side toward the sclera, and were covered with a whitish, purulent discharge.

On the right eye the ulcer confined itself mostly to the fold of the conjunctiva, while on the left it extended up on the sclera almost to the ciliary region but, while the episcleral tissue was infiltrated, I could at no time find evidence of real involvement of the sclerotic coat. Such an ulcer, of course, suggested the idea of chancroid, but neither the history nor subsequent course of the disease bore out this theory of its origin. She had been spending several weeks in the country, and after walking through a field, among high weeds, had been attacked with violent inflammation of the face and eyes, accompanied by severe pain and marked chemosis. Of the two physicians in the country who saw her while in this state, and treated her for a week or more before she was brought to me, one pronounced her condition erysipelas, and the other a result of poisoning. As throwing some light on the cause of this disease, I elicited the fact that in December, 1887, some six months previous to the beginning of the present trouble,

a cut of the thumb, received while cutting meat, was followed by violent inflammation, resulting in the separation of a large slough, with destruction of the periosteum and exposure of the first phalanx of the thumb. This was accompanied by what was termed "erysipelas," manifesting itself by swelling of the arm, and what she described as "crusts and scabs" of the face. As a result of this she had tenderness on pressure over the malar bones. indicating a chronic periostitis, which, in varying degrees of intensity, has been one of the marked characteristics of her case throughout. Upon examining the eyes, I found the upper lids healthy, the corneæ clear, the irides and pupils normal. The vision of the right eye was reduced to light-perception, but the ophthalmoscope revealed the nerve and retina in an apparently normal condition. A careful consideration of all the facts led her uncle, Dr. S., and myself to the conclusion that inherited syphilis, of which there was good evidence, was at least an important element in the case, and her constitutional treatment was directed against that disease. She was given the protiodide of mercury, atropia was instilled, the ulcers were stimulated with a solution of nitrate of silver and a solution of the bichloride of mercury-I to 5000—was given, to be used as a solution in cleansing the ulcers.

This treatment, and dusting the ulcers with an impalpable powder of boracic acid, sufficed in a few days to check the ulcerative process, and they gradually improved. But, no sooner would we have the surface well healed, and begin to congratulate ourselves that at last our troubles were over, than suddenly, often in the course of a night, a cicatrix, which was covered with new-formed epithelium and seemed almost normal, would present itself as a deep, gangrenous ulcer, with a black slough in its centre, such as to excite the greatest apprehension as to the safety of the eye, and especially the danger of symblepharon. During the months from early in August to December this process continued, the ulceration alternating between the eyes, and seeming much more uncontrollable at her menstrual periods. In each case recovery was good, and only slight symblepharon and white cicatrices remained to mark the site of the ulcers. Vision was defective, being reduced to light-perception at times, but it varied greatly, and this in spite of the fact that a careful scrutiny of the fundus revealed no lesion of nerve or retina.

When at last, after four months of treatment, the ulcerative process was checked, her vision, which with proper glasses had been

normal, was found to be as follows: R E,  $\frac{4}{24}$ ; L E,  $\frac{2}{60}$ . This has since greatly improved.1

The periosteal tenderness, which had been a constant symptom, became more marked about this time, and extended to the region of the right ear. My experience with the eyes led me to make an unfavorable prognosis for the ear. The following notes from my case-book will illustrate the progress of the disease after the ear was attacked.

December 9, 1888.—Examination reveals tenderness on pressure in the superior mastoid region, and in the posterior superior wall of the external auditory meatus of the right ear. Membrana tympani slightly retracted, but otherwise apparently normal.

December 10th.—The patient complains that there has been aching of the ear since yesterday with considerable hemorrhage. Loud-voice-sounds are now only heard within four inches of the ear, and on examination I find a focus of inflammation, with swelling and great tenderness in the superior portion of the external auditory meatus, near the auricle. The hemorrhage evidently came from the tympanic cavity.

December 11th.—Under the action of leeching and frequent syringing with hot water, the above symptoms were relieved and the condition of the ear greatly improved.

December 23d.—With the exception of slight tenderness at the apex, the mastoid tenderness has almost entirely disappeared under the above local treatment, with the constitutional treatment which was instituted when the eyes were first affected. The tenderness over the malar bone and the earache continue, and for two or three days past there has been a sero-sanguinolent, tending to a purulent, discharge. The extreme tenderness in the posterior wall of the external auditory meatus has disappeared, and the swelling has subsided so that a view of the membrana tympani can now be obtained. The membrane is pale, thin, and parchment-like, with two perforations in the central and lower portion.

December 28th.—Greatly improved. The ear is now free from pain, the secretion has almost entirely ceased under the use of

<sup>1</sup> On June 26, 1889, Vision, with the proper correcting glasses, was found to have increased to: R. E.,  $\frac{4}{6}$ ; L. E.,  $\frac{4}{6}$ .

A careful study, with McHardy's self-registering perimeter, revealed, for the

left eye, a normal visual field; while the right was irregular and was reduced to less than 35°

At a still later period, August 5, 1889, after another similar attack of inflammation of the lower lid of the *left* eye, its vision was reduced to  $\frac{4}{12}$ , and its visual field to less than 45°; while the ophthalmoscope revealed no gross lesion of retina or nerve.

boracic acid, and for the first time I succeeded in inflating by Politzer's method.

Fanuary 7, 1889.—I was called to see the patient at her home, and found her in bed, where she had been for a week.

After her last visit to my office she had been free from pain until the following day, when she had severe pain in the ear, coming on without apparent cause. The pain became more and more severe and, owing to weakness and dizziness, she was obliged to take to her bed. There had been great swelling about the face and ear, but no discharge until to-day. For several days there had been paralysis of the right side of the face, immobility of all the muscles, mouth drawn to the left, eye staring wide open, etc., etc. The patient's mind was clear, there was no evidence of meningitis, (?) and I found on examination great tenderness of the cheek and over the mastoid region, and scanty discharge, owing to closure of the meatus by swelling and the presence of large, partially detached, leathery masses sloughing away from the auricle and external meatus.

The periosteal tenderness, and the blackish, gangrenous appearance of the ulceration established the fact that we here had to deal, as I had concluded when the ear was at first attacked, with the same process that had proved so obstinate in the eyes. Here, however, its course was modified by the nature of the tissues, but rendered far more dangerous and difficult to control owing to the delicacy of the parts involved and their inaccessibility.

After an hour or more of work with syringe, cotton-probe, and curette I succeeded in opening a narrow channel to the middle ear, and removing some exfoliated masses and a little blood-stained pus. I directed syringing with a solution of bichloride of mercury, with frequent cleansing of the ear by means of the cotton-probe, etc., and, in order to facilitate the removal of the partially exfoliated, leathery sloughs that were obstructing the external meatus, and thus to favor the discharge of the pus formed in the middle ear, I directed that a poultice be applied. Owing to the very imperfect outlet for pus and the virulent nature of the disease, as witnessed in the eyes, I felt great solicitude, not only for the hearing but for the life of the patient, and so expressed myself to the friends. Yielding to the importunities of the child, who naturally dreaded the pain accompanying treatment, they did not send for me again. Finding they could control the symptoms, as they supposed, by the syringing, they carried out the treatment at home, sending her to me again at the end of a month.

February 3d.—Returns much improved as to her general condition. Paralysis of the seventh nerve continues, but now is not complete as there is slight movement of the lid. Total deafness of the right ear; tuning-fork not heard on the right side. On examination I found marked tenderness over the right, with slight tenderness of the left side of the head. Intense tenderness about the mastoid, but no swelling. A small cicatrix over the mastoid indicates the spot where during her illness a small, superficial abscess was opened, allowing the escape of a small amount of greenish pus. which evidently came from the sub-periosteal inflammation rather than from the mastoid cells. The external meatus is still greatly obstructed. At a point about the junction of the cartilaginous with the bony meatus I found extensive denudation of bone, and a large opening downward and backward, through which I could pass a probe one third of an inch into what I at first supposed was the mastoid process, but which proved to be a cavity formed by sloughing away of the inner portion of the cartilaginous process. The loss of the greater part of the tragus was also discovered to have been one of the results of this destructive process.

February 10th.—After much tedious treatment in removing the necrosed tissue and allaying local inflammation I am now enabled to obtain a good view into the ear, and it presents a remarkable appearance. The rough edge of the osseous external auditory meatus is laid bare through the lower and posterior two thirds of its circumference. The inner portion of the cartilaginous meatus seems to be necrosed or drawn away so as to leave a large cavity. The osseous meatus is denuded throughout the same portion of its circumference as far as it can be seen; at least as far as the tym-To my surprise the patient states that she last night discovered that she could hear with this ear! For about ten minutes she had had a "heavy, digging" sensation in her right ear. She was lying on her left ear and could hear nothing with it, but she heard the clock strike and told her mother it was wrong for it only struck five, whereas it was twelve o'clock at night. I was disposed to doubt so curious a coincidence as the sudden restoration of hearing while the clock was striking the hour; but a careful test established the fact that, in spite of the extensive loss of tissue, she could hear conversational tones at fifteen feet. I find that now the function of the facial nerve is so far restored that the patient can by an effort close the right eye; and a peculiar feature of the case, is that, in attempting to close the eye, a small group of

fibres of the orbicularis seem to act alone, and the lower lid stands out erect and away from the eyeball at its inner two thirds. Treatment: syringing with carbolized water, careful drying, and cleansing with curette and cotton-probe, use of peroxide of hydrogen to cleanse the irregular, out-of-the way crevasses, drying, and the use of Wyeth's boracic acid with the salicylate of chinoline.

March 10th.—The patient now states that for the last two weeks she has had loss of taste on the right side of the mouth. This I confirmed by the use of salt on the tongue. One month previous to this time this was not the case, as I examined carefully with reference to it. The removal of the necrosed tissue seems to be complete, and a careful examination reveals the following condition: With the exception of a small area of the upper, anterior wall of the external meatus, no soft tissue is to be seen either in the bony canal or the tympanum. All is clean, ivory-like bone. The ossicles are absent, and on the inner wall of the tympanum is to be seen the fenestra ovalis, and less distinctly, the fenestra rotunda. The outlines of the fenestra ovalis are clear cut and distinct, but it seems to be closed by a pellicle or membrane.

In spite of this extensive destruction of tissue, and the absence of so many parts often considered essential to any thing more than mere perception of loud sounds, I found that our patient had what might be termed good hearing. To be sure that I made no mistake, I took special precautions and made several careful tests and still found that she undoubtedly heard with her right ear, and repeated correctly conversation in ordinary tones at thirty-five feet and whispered words at sixteen feet.

May 3, 1889.—Since the above date the patient has been visiting friends in a distant part of the State, where her treatment has been conducted without the aid of the mirror, or other illumination than that furnished by the sun at a window.

She returns with hearing greatly reduced, profuse discharge, and polypi filling half the calibre of the external meatus.

Fearing that there might still be room for doubt as to the accuracy of my tests of the hearing of the right ear and the perfect ex-

<sup>&</sup>lt;sup>1</sup> Later the ossicles were found lying loose in the tympanic cavity and were removed by syringing and the aid of the forceps. Their surfaces were eroded, and the processus gracilis of the malleus was absent. They had no firm attachments, and had lain concealed for weeks in the recesses of the tympanic cavity.

clusion of the left, I had awaited her return before publishing an account of her case.

My disappointment therefore was great on discovering that exuberant granulations had again been allowed to develop, which must of necessity interfere seriously with her hearing. To my surprise, however, she could still hear with the diseased ear.

With the finger firmly pressed into the left meatus she heard whispered voice at six inches, conversational tones at twenty-nine feet, and the tick of a watch at one inch= $\frac{1}{60}$ . The tuning-fork on the vertex was also heard in the right ear, though heard better in the left.

A few days later, after removal of the polypi, I found hearing had increased so that she could hear the watch at six inches,  $=\frac{6}{60}$ , and she reported that she had been able to hear conversation over the telephone with the receiver applied to the right ear. With such extensive denudation of bone and, in spite of all treatment, the continuance in a subdued form of the periostitis which preceded the attack of otitis, one can hold out little hope as to the result. It illustrates, however, the possibility of a fair degree of hearing in the absence of all the ossicles; and presents the unusual phenomenon of the separation of the stapes with the preservation of a membrane closing the fenestra ovalis and retaining the perilymph.

Closing the right ear and making the same test—the left remaining closed—no sound was heard.

 $<sup>^1</sup>$  On July 29, 1889, another careful test of the hearing of the right ear was made with the following result: after careful closure of the left ear, whispered voice was heard at 43 inches; watch test,  $\frac{8}{60}$ .

### CONTRIBUTION TO THE PHYSIOLOGY OF THE SOFT PALATE.

By OTTO JOACHIM, New ORLEANS, LA.

Translated by ARNOLD H. KNAPP, A.B.

ROF. B. FRÄNKEL kindly sent me a patient whose entire external nose and septum nasi was destroyed by disease. For several years the patient was used by Prof. Fränkel for intra vitam demonstrations of the nasal pharvnx, the Eustachian tubes, and the processes of speaking, swallowing, etc. Such patients, in whom the functions have remained normal (even the sense of smell was perfect in this case), are, as Voltolini says, rare, and should be made the subject of detailed investigation. I gladly seized the opportunity to study these processes by ocular inspection, and to compare my own observations with those of others. In the perusal of the literature on the subject which Prof. Fränkel kindly placed at my disposal, I found that the opinions of authors were in many respects divergent, especially in regard to the completeness and manner of the closure of the isthmus pharyngo-nasalis during phonation, and in regard to the conditions of the orifice of the tube during deglutition and phonation. Passavant has extensively and critically discussed the views of different authors up to the time of his own paper, so that I only wish to quote some passages from later works in order to call attention to the still existing discrepancies of observation.

Passavant's results have been frequently doubted, and differently explained. He made his observations on Dr. Moritz Schmidt, on himself, and on patients with defects of

the palate. At the close of his paper he says: "By the simultaneous action of the levator palati and the superior constrictor of the pharynx, the horizontally raised part of the soft palate touches the advancing intumescence of the posterior pharyngeal wall, and thus the closure is effected." We find this still more emphasized in a later communication, in which he says: "The object to which I have sought to draw attention in my paper on the closure of the mouth during speech is the isolated action of the superior constrictor of the pharynx, its ridge-like projection behind the soft palate, both antero-posteriorly and laterally, toward the centre, producing the complete closure of the palatal valve, which is necessary to effect intelligible speech, while at the same time the soft palate is raised and drawn backward."

GENTZEN. in an excellent paper, asserts that he has observed the transverse ridge. He says: "The posterior wall protruded in the form of a transverse prominence, exactly as Passavant has described. As soon as the letter ceased to sound the soft palate fell suddenly, and I could see at once how the posterior wall of the pharynx retracted and its folds smoothed themselves out."

VOLTOLINI, from the results of experiments, states as follows: "In speaking there is no complete separation of the naso-pharynx from the laryngo-pharynx, but a 'transverse ridge ' is always formed." He considers the closure of the palate an essentially sphincter-like action, but acknowledges that the transverse ridge is not always visible, even that it cannot at all times be observed in the same individual.

THECHNER 2 says: "Articulation is not effected by this alone, but from the wall of the pharynx a ridge projects, as Passavant first observed. I can prove this fact from my rhinoscopic observations."

VOGEL, in his paper, agrees with the views of these authors: "Simultaneously with the elevation of the soft

<sup>1 &</sup>quot;Observations on the Palate After Removal of an Orbital Tumor," Königsberg, 1876.
"Phonetics," p. 29.

<sup>&</sup>quot;Observations on the Pharynx of a Man with a Complete Defect of the Nose," Dorpat, 1882.

palate we observe that the posterior wall of the pharynx projects forward, so that both join. By suitable illumination we plainly see, especially if a short a is pronounced in the moment at which the soft palate falls again, a simultaneous retrocession of a ridge on the posterior wall of the pharynx. the greatest conversity of which is somewhat under the level of the hard palate on the lower edge of the pharyngeal tonsil.

Opposed to these views are MICHEL'S 'observations. In a case similar to ours Michel was unable to confirm the presence of a transverse ridge. The results which he has arrived at through rhinoscopic investigations are: "That the formation of the transverse ridge is the exception, and not requisite for articulate speech. It does not depend merely upon the action of the superior constrictor, but on a powerful co-operative movement of the posterior wall and the pillars of the fauces, so that the transverse ridge is a pathological appearance of a compensatory nature, as in case of defective palate or conditions of paralysis." He claims to have observed two longitudinal ridges in his patients during deglutition, without, however, giving us complete information on this point.

LUCÆ, in his case, has, it seems, also been unable to observe a transverse ridge. He says: "During the simultaneous narrowing of the Eustachian tubes the soft palate takes a horizontal position to the posterior wall of the pharynx."

In opposition to Voltolini, HARTMANN's came to the conclusion, by delicate manometric investigations, that closure during phonation was complete. Even if only a minimum pressure, for instance (20 mm of water in the nostrils), is used, the position of the manometer remains constant as long as the phonation lasts, with the exception of a. In seven persons in whom the condition of these organs could be considered normal, pressures of from 30 to 100 mm of mercury were necessary to overcome the

<sup>&</sup>lt;sup>1</sup> Berl. klin., Woch., No. 41, 1875. <sup>2</sup> Virchow's Arch., lxiv.

<sup>&</sup>lt;sup>3</sup> Centralbl. f. d. med. Wissensch., No. 15, 1880.

resistance of the soft palate during the formation of a vowel.

B. FRÄNKEL, however, is of the opinion that no hermetic closure of the isthmus exists during phonation, but that more often the air column in the buccal and nasal portions of the pharynx remains continuous; the velum palati in particular does not apply air-tight to the lateral parts. We find equally opposed views on the relations of the orifices of the Eustachian tubes, during deglutition and phonation, TOYNBEE, POLITZER, MICHEL, TRÖLTSCH, and others, in consequence of their observations and experiments, agreed with the opinion of Valsalva, that the tube is opened during the act of swallowing. Lately Zaufal2 has adopted the same standpoint, and illustrated it by photographic views of the orifices of the tubes, taken during the acts of swallowing and phonation. LUCE opposed this, both in word and writing. VOLTOLINI, who in his work critically discussed the papers of Michel, Lucæ, Zaufal, and others, arrives, by his experiments, at Valsalva's views. Hartmann by a series of detailed and very instructive investigations in the pneumatic cabinet has proved this supposition to be a fact.

The patient who furnished me opportunity for observation, a tall strong man, 38 years old, acquired syphilis about 12 years ago. He stated that during the last 5 years he had lost his nose. For several years he had been under clinical treatment, and healing did not take place until after the removal of large sequestra and repeated scraping operations. His entire outer nose, the whole septum, on the left side all the turbinated bones with the exception of a remnant of the superior, on the right the superior and the inferior, were lost; the oval opening is bounded on the left side by the superior turbinated bone, the orifice of the tube, the lateral wall of the naso-pharynx, a cicatricial mass lining the antrum of Highmore,—the partition wall between the nasal cavity and the mouth is also

<sup>2</sup> Arch. f. Ohrenheilk., ix., pp. 133 and 228. <sup>3</sup> Virchov's Arch., lxiv.

Uber adenoide Vegetationen, Deutsche med. Woch., No. 41, etc., 1884.

<sup>4 &</sup>quot;Experimentelle Studien über die Funktion der E. Röhre," Berlin, 1878.

lost. On the right the partition between the antrum and the nose, as well as the middle turbinated bone, is preserved. Although large pieces of the hard palate are lost, there is no perforation of the inferior wall, and the large cavity is bounded below by the hard and the soft palates behind by the posterior wall of the larynx. The upper lip is thickened, but entirely capable of performing its function. The preserved mucous membrane now presents a nearly normal appearance, so that the patient has submitted to an operation for the restoration of his nose.

The loss of soft parts and bones which the patient has suffered is so great, that the naso-pharyngeal cavity is most conveniently visible from in front through the large opening; the Eustachian tubes, for instance, appear as if they lay outside on the face. The orifice of the left tube is occluded and impervious, with a considerably reduced power of hearing on that side. The tonsil of Luschka is greatly atrophied. The fossæ of Rosenmüller are flat and form a shallow transition from the posterior to the lateral wall of the pharynx, forming slight folds during phonation. The anterior labium of the tube passes obliquely backward and downward into the superior surface of the soft palate, while the posterior labium can be followed with the mirror as a muscular cord to the posterior surface of the uvula. During the elevation of the palate the prominence of the levator palati pushes itself between the two labia, yet does not completely block the orifices of the tubes, so that a circular opening remains between the walls of the orifices of the tubes and the highest point of the prominence of the levator palati, the axis of which does not correspond to the tubal cleft in the position of rest. During phonation the mouths of both tubes face each other. The patient can smell perfectly well, and his speech shows neither a nasal twang nor an altered resonance. During rest the soft palate slopes from its insertion steeply downwards, and disappears from view. With a mirror, introduced as far as the wall of pharynx, a convex uneven surface is shown with a tuberculum over the base of the uvula; on both sides an elevation of the levator palati, as well as the above-mentioned cords, which pass from the posterior lip of the tube to the posterior surface of the uvula, is noticed. The interval between the soft palate and the posterior wall of the pharynx is so great as to expose, in a favorable position, the posterior half of the vocal cords. The uvula itself is bent forward, and not visible. In quiet breathing the soft palate remains unaltered in this position. Prolonged examination discovers an irregular twitching here and there. In deep breathing, with the mouth closed, there is usually no irregular movement to be seen; often, however, an elevation of the velum palati to the level of the hard palate can be noticed in deep inspiration, as well as in forced expiration. When the mouth is open these appearances are rarer and much weaker.

Regular movements, varying, however, in intensity, occur particularly in phonation and deglutition, also in coughing, retching, yawning, etc. When I requested the patient to phonate, which usually was done with the sounding of an o, I first noticed the elevation of the soft palate at its place of insertion, the point which had to make the shortest excursion. In this point I differ from the observations of Michel and Vogel, who allege to have seen in phonation the first movement at the orifice of the tube. The soft palate is raised entire, but as the posterior parts have to go over a greater distance, the elevation appears wave-like. The intumescence of the levator palati increases during this process, and, so to speak, crowds between the lips of the orifice of the tube, whereby principally the posterior lip moves back and up. I could perceive a minimum forward motion only in the lowest part of the anterior lip, and not before the elevation of the ridge of the levator palati. This observation agrees with that of Lucæ, excepting that in my case the backward movement seemed to have been smaller; it is, however, different from that of Michel, who noticed that the lower ends of the orifices of the tube approach the centre of the head of the pharynx. Vogel's observation differed from mine, inasmuch as he perceived the first movement at the orifice of the anterior lip. From the observations made on this patient I came to the conclusion that the tube opens during the act of swallowing, as it was possible to look deeply into the gaping ostium, when the patient was examined for a length of time, during which the mucous membrane would become dry.

In the position of rest the lips of the orifice of the tube are in contact in their whole extent, and the cleft is turned forward. When the soft palate has reached its highest point, it lies more or less close to the posterior wall of the pharynx and above the level of the hard palate, remains in that position without any perceptible motion during phonation, and, in toto, sinks entirely back to its place of rest at the cessation of speech.

I have taken especial pains in this patient to examine the relation of the soft palate to the posterior wall of the pharynx during phonation, deglutition, etc. Passavant's ridge was present in my patient, though not developed to a marked degree. It was best visible in short vocal sounds, and appeared as fine stripes on the posterior wall of the palate opposite the ridge at the basis uvulæ. The closure of the naso-pharyngeal cavity was aided on the sides also by the protrusion of the lateral wall of the pharynx. The closure never was complete during the sounding of the vowel a, and the soft palate never reached the level of the hard palate. In the sounding of e and o, the soft palate was in contact; left, however, a small cleft on both sides of the tuberculum veli. This cleft became more apparent after longer examination, through the drying of the mucous membrane. The sounding of i and u produced complete closure. The soft palate rises to complete closure in the pronunciation of a consonant without the accompanying vowel, except in the case of m, n, and h. I did not repeat the experiments of Passavant on Dr. Moritz Schmidt, for I could satisfy myself by direct observation that in the sounding of a no complete closure was produced, while in the case of i and u the closure was always perfect. With e and o the closure was not so complete.

To determine the height to which the soft palate is raised during phonation, deglutition, etc., I repeated the experiments of Gentzen and Vogel with a similar lever apparatus and Marey's drum, which were kindly placed at my disposal in the Physiological Institute at Berlin by Professor Gad. The results which I obtained by the tracings of this very sensitive instrument agree in general with the results obtained by other authors. The greatest elevation was produced in the vowels by u; i, o, e, and a following in the order named. A u sung with steadily increasing pitch shows the upper line unchanged in the same level. Also in the other vowels it could not be ascertained that the pitch of a tone had any influence on the elevation of the soft palate. Lucæ is not of this opinion, but thinks that a higher pitch of a sound produces a raising of the soft palate. The diphthongs ai, ei, oi do not raise the soft palate so high as i does, whereas ui raised it higher. In the pronunciation of vowels with succeeding or preceding consonants, the line ascends without interruption to the summit, and falls straightway in the same manner. I could not notice a stay of the soft palate at the height of the corresponding co-vibrating vowel, as has been described by Gentzen.

Vowels pronounced with a nasal twang raise the soft palate, but do not produce a closure. M and n do not occasion a change in the place of rest of the soft palate; h does not raise it. I cannot confirm the remarkable differences which Vogel found in the pronunciation of the different consonants. T produced the largest excursion. K, g, and d almost reached the same level. The remaining consonants show little difference between themselves and those just named. L produced the smallest excursion. R made the soft palate visibly vibrate, and the vibrations could easily be counted with the magnifier. The pronunciation of words with many vowels produces a curve, with an irregular upper line; when, however, m or n is present in a word, the soft palate falls almost to the places corresponding to those consonants, almost to its position of rest. Deglutition produces an elevation of the soft palate above the height of phonation, but neither before nor after it was I able to observe still deeper a sinking, as Gentzen has done. The ascending line is more oblique than in the case of phonation; the descending line shows a rest in the middle, after

which the soft palate returns more slowly to the place of rest. The photographic pictures were taken during empty swallowing. Coughing produced a curve very similar to that of k. Attempts at snoring formed an excursion somewhat less than coughing. Retching caused the highest excursion of the soft palate ever noticed. A marked negative excursion (sinking below the place of rest) was noticeable during sighing.

These values were obtained by laying on the middle line of the soft palate a wire that was curved upwards. Less reliable results were obtained by applying an eyelet, which covered the greater part of the soft palate. I have examined my patient with regard to these points, and can confirm in general the reports of other authors. Nevertheless, they differ in some points. From the observations which I was able to make, I came to the following conclusion: that the soft palate influences speech only by separating the mouth from the nasal cavity as far as it is necessary for the formation of speech; moreover, that the loss of the nose does not impair its function as a resonance-box.

## ADDITIONAL BOTANICAL AND CLINICAL CONTRIBUTIONS TO OTOMYCOSIS.

By F. SIEBENMANN, BÂLE.

Translated by Dr. MAX TOEPLITZ, New York.

(With plate i. of vol. xix., German edition.)

THE human ear proves more and more to be a mine of pathogenic fungi. Strange to say, as is apparent from our synopsis, the kinds and species first therein discovered are now found more rarely, and in their place a number of others, to a certain extent already known for some time as pathogenic, play a prominent part. Hence we receive the impression that with the increase of our mycological knowledge additional botanical discoveries can here still be made, and that we should as yet not be satisfied with the knowledge thus far acquired in this field.

In the year 1883 I published, with the kind aid of the late and deeply lamented Prof. A. Burckhardt-Merian, an extensive monograph upon the occurrence of moulds in the human ear, upon their position in the botanical system, their biology, and their metabolic changes upon dead material and in the living body. I took from my own material and that of others only the Eurotia and Aspergilli, principally because this genus was at that time botanically well-known.

By the kind request of my highly esteemed teacher and colleague, Prof. Bezold, of Munich, I shall publish in this paper those of his cases of the last six years which belong to this subject and are kindly placed at my disposal, and shall without selection treat statistically of all the cases.

Prof. Bezold, as is known from his writings, has at all times paid much attention to otomycosis, and has thus seen during this period fifty-two well observed cases in which fungi were microscopically looked for, after the diagnosis had been macroscopically ascertained.

The specimens of moulds, as many as were obtained, well preserved mostly in glycerine or alcohol, belonged to the corresponding histories of cases, and were carefully examined. The result of this re-examination is discussed in a special part, which I place at the head of the paper, since it offers the most additional knowledge.

CASE I.-A. S., from the country, æt. 37.

January 20, 1881.—For three to four years hardness of hearing; two maternal relatives hard of hearing. On the left side for four weeks, after an eruption of the face and head, pain in the ear, for which a week ago oil was instilled. The last few days there exist discharge, increased hardness of hearing, and intense pain.

An epidermis ring, coated with aspergillus fumigatus and saturated with oil, is removed with the syringe. Further treatment consists in instillations of a two-per-cent. solution of salicylic alcohol into the ear three times a day for ten minutes, and a daily injection of solution of boric acid. All other patients reported in this paper underwent the same treatment, unless another method is expressly stated, so as to enable us to omit further mention of this treatment in the following histories of cases.

CASE 2.-George B., æt. 40.

February 3, 1881.—For two days discharge and hardness of hearing in the left ear. Relapse of otorrhœa, without pain. Discolored, partly brownish, partly whitish masses were removed from the bottom with the syringe. The result of the microscopical examination is as follows:

Much free fat; numerous round, colorless spores of different size; mycelium, with enclosed fat globules, partially of great abundance; much branched, thick fruit hyphens, with pretty thick walls, and with formations of septa occurring more frequently near the fructifications, at places deep-brown coloration of the wall. First development of the fruit bearers, with a thickening upon which several root-like, short, rounded mycelium threads are situated. The hyphens show here and there swellings in their

continuity; these places as well as others enclose deep-brown spots, which seem at the walls to project inwardly. On their extremities the hyphens bear one, or, when branching, two or three capsules. The latter are mostly oval or round, pale, brownish, frequently torn or folded. The great majority are empty. Some are dark-brown, and enclose spores.

CASE 3.-Miss B., æt. 58.

April, 1881.—Otorrhæa for 12 years. Instillations of oil for six years for relief of tickling. One and a half years ago "black membranes" were removed with syringe. A day previous to consultation two little gray membranes came out of the ear. The syringe removed from the bottom similar gray, partly sanguinous shreds, which consisted microscopically of an abundant very delicate mycelium net, full of fat globules. On treatment with salicylic acid no relapse occurred during the following twenty days.

In May, 1882, the patient presented herself again with otitis externa of the same ear, associated at times with pain, some discharge and cedema of the external auditory meatus. The discharge, consists mostly of numerous short rod-like bacteria (my examination of this specimen resulted in complete absence of hyphomycetes). After injecting and powdering with iodoform the discharge ceased.

Later, in December, 1882, an aural furuncle on the right side was treated.

CASE 4.-X. v. H., æt. 26.

May, 1881.—The patient suffered from discharges as a boy. Bilateral residues of otitis med. pur. with persisting perforation. Instillations of oil for one year.

Both meat, aud, ext, are filled at the bottom with crusts, which are covered by a small aspergillus with little heads bearing small whitish spores.

CASE 5.-G., æt. 35, from the country.

Fuly 9, 1881.—Bilateral otomycosis after instillation of oil. External meatuses swollen and diffusely reddened, and also part of the drum. The aural affection existed 6 weeks, instillation of oil made for 4 weeks. Small form of aspergillus with oil masses within and without the mycelium; small oval spores.

CASE 6 .- L. H., æt. 42.

Fuly 12, 1881.—On the left aspergillus fumigatus after instillation of oil.

Fuly 15th.—New moulds are found.

CASE 7 .- A. H., æt. 24.

September 19, 1882.—On the right side otit. med. pur. chron. Three days ago instillation of oil, pain in the ear since then, especially upon pressure on the auditory meatus; at the bottom of this a plug is found, which is softened until the following day.

November 20th.—The pain has ceased, a plug with aspergillus

niger was removed with the syringe.

December 3d.—Formation of moulds disappeared. Defect of the posterior half of the drum membrane. Discharge has ceased. Hearing power not improved.

CASE 8.-S. T., æt. 36, from the country.

November 18, 1882.—Bilateral hardness of hearing. On the right ear what appears to be a ceruminal plug. This is softened and removed the following day. It consists in its outer part of cerumen. The inner portion is a black mass surrounded by numerous white lamellæ. Large clusters of spores and fruit bearers, aspergillus niger; the latter, partially filled with fat, are revealed by the microscope. No heads and no mycelium. [The patient six months ago had poured into the ear oleum amygdal, several times with a coffee spoon.]

Case 9.- J. B., æt. 60, from the country.

Bilateral destruction of the drum-membrane, save a small upper remnant. Discharge and hardness of hearing for 40 years after "mucous and nervous fever" (typhoid existed). The tympanic walls exhibit at present moderate redness. Both meat, aud. ext. lined with dried secretions bearing a white coating. The latter consists of colorless spores and thin mycelium, containing a few fat globules.

CASE 10.-Lt., æt. 28.

March 7, 1882.—Pain in the left ear for a week; serious discharge lasting 4 days. A week ago and the following days, frequent instillations of ol. amygd. on account of the pain. Last night increase of pain so as to cause sleeplessness. Asperg. niger and extensive deposits of epidermis upon the meat. audit. ext., and upon the drum-membrane.

March 8th .- A few flakes of pus.

March 9th.—The same condition. Extensive swelling of the cartilaginous ext. meat., obstructing it to a chink. At the upper wall a furuncle is emptied.

March 10th.—Another furuncle; the same condition on the 12th.

March 14th.—Profuse suppuration and formation of croupous membrane.

March 15th.—Additional furuncle.

March 18th.—Suppuration has ceased.

March -th.-Hearing for watch normal.

CASE 11.-Dr. R., æt. 38.

April 28, 1882.—Bilateral ceruminal plugs; softening.

March 29th.-Microscopical examination revealed fructifications and mycelia of asperg. fumigat. Last August instillations of oil had been made.

April 11th.—Normal condition.

CASE 12.-G. W., æt. 62, from the country.

May 26th.—Hardness of hearing on the left ear for 20 years. Four weeks ago instillation of oil. Two weeks subsequently impairment of hearing, associated with serous discharge and itch-The last two days intense pain in the entire left ear, sleeplessness, and impossibility of masticating. The cartilaginous extern, meat, is swollen, Upon the drum-membrane whitish yellow deposits consisting microscopically of aspergill, niger.

Fune 1st.—Relapse, with small head-bearing, thin-membranous, and thimble-shaped casts.

June 6th.—Ext. meat. free from aspergillus.

CASE 13.-Mrs. L-, æt. 45, from the country.

Fuly 20th.—Patient suffered from discharge as a child and three years ago. At the latter period instillations of oil were made. Discharge has lasted now eight weeks and is associated with pain and itching. With the appearance of the discharge additional instillations of oil were made.

Asperg. fumigatus is found with the microscope in the secretions. The following day no itching.

CASE 14.-D. æt. 39.

September 15, 1882.—Six weeks ago moderate discharge and tickling in the left ear without real pain.

August 25th.-A white glove-shaped mass was removed with the syringe from the left ear. Two weeks ago cotton soaked with oil was placed into the ear, and also three days ago.

Both meatuses contain whitish masses and at the bottom creamy fluid which exhibits microscopically large masses of micrococci. Offensive odor of the secretion. The removed masses contain mycelium with fructification of asper, fumig. By September 19th the ext. meat. is dry.

CASE 15.-K., æt. 41.

October 13th, 1882.—Bilateral inflammations beginning in the spring with frequent relapses and alternate discharges from both ears. At each attack sleeplessness for a few days and humming noises in the ear. These appearances presented themselves anew five days ago on the left ear. The removed masses consist of mycelium without fructifications and of bacilli and also of pus cells. Hearing almost normal. Instillations of oil had not preceded. Patient works in a flax- and hemp-spinning establishment, where he is exposed to much dust.

CASE 16.-K., æt. 40.

November 2, 1882.—For four weeks swelling in the right ear and watery discharge. Instillations of oil, not until two days ago. Aspergillus fumigatus, in the mycelium of which no oil can be found. On the 27th normal conditions are recorded, also concerning the hearing distance.

CASE 17.—Dr. —, æt. 57.

January 25, 1883.—Nine months ago instillations of a solution of iodine and iodide of potash in glycerine were made into the right ear on account of subjective noises, and also two days ago. In the right meat. oss. a white-coated plug is found, after the removal of which the drum-membrane appears somewhat dull, otherwise normal. The white masses consist of mycelium and colorless spores. Upon the external surface of the mould-membrane I found at places a finely granular dark thin layer, in which the brown club-shaped conidium bearers and also partly preserved small heads of aspergillus nidulans were found.

CASE 18.-E. H., æt. 28.

April 13, 1883.—Ol. hyoscyami and chloroform aa were prescribed to the patient, with the order to place cotton plugs soaked in this solution into the external meatus.

December 14th.—Frequent instillation of the oil. A week ago tickling and a discharge for a short time. Day before yesterday intense pain in the ear. A thick epidermis cast containing aspergillus niger was removed with the syringe.

December 16th .- The pain has ceased.

CASE 19.-S. D., æt. 25.

Fune 7, 1883.—Otomycosis dextra.

For two years or more, 3 to 4 times a year, a slight discharge, tickling, and sensation of stopping up in the right ear, which suddenly passes away.

241

Epidermis of the right ext. meat. macerated and soaked with serous discharge. Drum-membrane appears dark and free from deposits. Handle of the malleus visible. Small brownish lamella bearing much gnarly mycelium abounding in fat granules and with conidia is removed with the syringe, and also numerous bacteria.

Fuly 8th.—No discharge from the ext. meat.

CASE 20.-K., æt. 58; gardener.

Fune 10, 1883.—For 4 to 5 years impairment of hearing. A year and a half ago a bilateral discharge, somewhat fetid, appeared. K. has placed into the ear for a year cotton soaked in oil twice a week. The offensive discharge was at times removed with the ear-spoon in large pieces. The syringe removed to-day mucous dirty-yellow masses containing Verticillium and "Graphium penicilloides," and also large masses of bacteria.

CASE 21.-Ak., æt. 40.

September 20, 1883.—Bilateral otomycosis. Patient has instilled rancid "ear-oil" with a small glass syringe for six months every two weeks. Since that time, frequent tickling in both ears. Three months ago he removed a mass the size of a pea from the right ear without having a discharge. For four days the patient noticed impairment of hearing on the left ear, a sensation of its being stopped up.

The syringe removed fat and masses of epidermis with abundant dendriform, thick mycelium without fructifications. Under the microscope abundant delicate mycelium, which appears in all its loops imbued with fat; the darker portions contain very numerous small heads of aspergillus fumigatus.

October 5th.-Cured.

CASE 22.-D., æt. 28, from the country.

Four weeks ago sudden pain in the left ear. The same day profuse discharge of a brownish fluid. The pain disappeared the following day; since that time the tickling persisted. After a week the discharge became yellow. For two weeks the patient instils oil into his ear.

December 30, 1883.—The external meatus is filled by a yellow, cheesy, extremely fetid mass. The secretion consists of epidermic detritus, pus corpuscles in disintegration, and a fair amount of mycelium threads, which enclose many air bubbles and many oil globules. The threads themselves are irregularly thick, gnarly, and branched.

CASE 23 .- M. F., æt. 57.

June 10, 1881.—Bilateral seguels of ot. med. pur.; in addition otomycosis dextra after instillation of oil, which does not cause any symptoms.

CASE 24 .- Z. A., æt. 61.

June 10, 1881.—Otitis media purulenta chronica with extensive perforation in both ears. In the right ear upon dried secretion whitish flaky masses of mould. In the left ear, large cheesy, gray-yellow masses are removed with a syringe. (Patient had made two years ago instillations of oil into both ears.) Formation of mould without causing any symptoms.

August 2d.—Abundant masses of epidermis and slight purulent secretion. In the secretion no mould elements.

CASE 25.-L., æt. 18.

November 28, 1882.—Otomycosis sinistra. For two years tickling and discharge in left ear, principally in the fall. Yellowish mass situated in front of the promontory consists almost exclusively of functifying mycelium of aspergillus fumigatus.

CASE 26.-M., æt. 37.

January 6, 1884.—Complete deafness in both ears since 1877. Three months ago an ear-oil was instilled. In the left ear upon a thin layer of cerumen and oil a turf of aspergillus fumigatus was observed.

CASE 27.-M., æt. 53.

January 9, 1884.—Otomycosis dextra. Last two months tickling. Three months ago instillation of oil, a simultaneous appearance of discharge with an offensive odor. In the removed masses a delicate mycelium, enclosing fat globules arranged like pearls, and also zoöglœa in abundance were found.

January 10th.—Discharge and odor have disappeared from the right ear.

CASE 28.-W. B., æt. 20.

April 26, 1884.—Bilateral residue of otit. med. pur. with persisting perforation after scarlatina five years ago. Bilateral defect of at least two thirds of the drum-membrane. Instillations of oil were made for a long time. The tympanic cavity of the left ear exhibits a whitish lining, which consists under the microscope of a small aspergillus and oil globules. The same is studded with small mould-heads with colorless spores.

CASE 29.-M. A., æt. 30.

September 27, 1884.—Otomycosis dextra. For several years

occasional serous discharge and tickling, which reappeared four weeks ago. For years repeated applications of glycerine and cold cream upon the external meatus as far as the finger could be introduced. The inner part of the cartilaginous and osseous external meatus is filled by a white mass, which can be removed as a whole by the forceps and forms a solid white cast of the external meatus. Only at isolated portions of its surface, brownish dirty small spots are found. The plug consists of epidermis, fat, bacteria, and moulds (moderately thick mycelium with numerous fat globules), round and pear-shaped conidia, and sheaf-formed hyphen bundles ("Graphium" and Verticillium).

CASE 30.—S. G., æt. 59, from the country.

October 12, 1884.—For four weeks pain and hardness of hearing in the right ear, the attending physician orders instillations of oil. Upon the posterior upper quadrant of the drum-membrane and upon the anterior lower osseous wall of the external meatus (here upon brown cerumen and fat), a white gray mould turf of aspergillus fumigatus is situated.

CASE 31.-E. H., æt. 24.

November 15, 1884.—Furuncles in the left external meatus for three weeks. Swelling obstructs the introitus to a chink. Relapses.

November 17th.—A plug of aspergillus niger with fat is removed with a syringe, together with a small croupous exudation. External meatus excoriated and swollen. Patient had three weeks previously instilled oil of almonds.

November 23d.-Additional furuncle.

November 24th.—Last visit to the patient no moulds were found.

CASE 32.- J. F., æt. 55.

Bilateral nervous deafness for six years.

March 16, 1885.—In the left ear a plug, apparently of cerumen, which consisted, when removed the following day, principally of aspergillus flavus and oil. (Patient had the year before used "ear-oil").

April 9th.—External ear normal.

CASE 33.-A. T., merchant, æt. 24.

Fune 3, 1885.—In the left ear residues with perforation persisting since childhood. Removal of the polypus with the snare two years previously by Prof. Bezold. Defect of entire drum-membrane, dried crusts in innermost portion of external meatus chan-

ging into white masses of epidermis. Tympanic cavity laid bare with glistening promontory.

Fune 30th.—In the osseous meatus a continuous turf of very small white heads of mould with colorless spores, thin hyphens, and mycelium. Tympanic cavity dry and pale; many yellow masses, consisting partly of pus corpuscles, partly of a large piece of fibrino-sanguinous exudation which is profusely interspersed with pus cells, are removed with the syringe. Copious serous secretion. Iodoform powder until July 7th.

Fuly 8th.—Two croupous shreds of exudation are removed with the syringe, and also on July 9th, 11th, and 13th. Discharge ceases on the 26th.

CASE 34 .-- F., æt. 82.

Dysacusis.

August 29, 1889.—Otomycosis sinistra; two years ago a feeling of deafness which had disappeared after injections of warm water and has not reappeared since. A few days ago the same feeling, and resonance of his own voice. Patient had formerly quite often and also in the last few weeks instilled "oil of white lilies." In the left ear at the bottom whitish hard masses, which appeared dark-brownish when scraped off with the probe. No discharge. External meatus narrow; somewhat swollen. In the right ear a white-coated mass prevents further inspection. Under the microscope partly epidermis, partly brownish masses of foreign substance are found. In portions of the specimen numerous hyphens and small heads, with a few colorless conidia, of the appearance of aspergillus fumigatus.

October 3d.—Removed the plug. No moulds were found.

CASE 35.-G. S., æt. 12; from the country.

October 5, 1885.—Since his fourth year hardness of hearing. In the right ear for two weeks pain and tickling; discharge for a week. Daily instillations of oil for two weeks by order of attending physician. The bottom of the right external meatus filled by a yellow-gray streaked moist mass of the size of a bean, which consists of a collection of aspergillus niger. The drum-membrane shows a round, bulged, somewhat excoriated place, corresponding to the region of the umbo.

October 6th.—Epidermis upon the drum-membrane almost entirely regenerated; the bulging disappeared; along the handle of the malleus diffuse redness.

CASE 36.-H. S., æt. 29.

Fanuary 10, 1886.—Plug at the bottom of right ear. A little

over two weeks ago repeated instillations of oil on account of hardness of hearing. The last few days tickling and some discharge. Dirty yellow at places; orange-red masses filling the bottom of the external meatus were removed with the syringe. The masses consisted of epidermis mycelium and conidia (corresponding to those of aspergillus flavus). A portion of this red but the reddish color is found in places outside of the mycelium in the mass. Drum-membrane shows besides maceration of the epidermis, a formation of the posterior fold. Until January 20th no relapses.

CASE 37.-T., æt. 75.

Formerly under treatment for hardness of hearing with negative result of examination (dysacusis).

February 23, 1886.—In the left meat. oss. a sanguineous cotton pellet plugging the meatus entirely, which was at its innermost portion corresponding to the form of the recessus firmly wedged in and blackish; at that time no microscopical examination.

February 25th.—Some tension around the ear. The bottom partly filled by gray masses. Large membranes with numerous black mould-heads upon very long bearers, which are not septate, contain air-bubbles, and frequently show at the base a short spurlike process, are removed with the syringe. Patient has been advised in summer of 1885 by a physician to place small pieces of lard upon cotton into the bottom of the ear.

CASE 38.—H. D., æt. 38.

August 3, 1886.—Four years ago he was under Prof. Bezold's treatment for mould-formation, and has the habit of meddling a great deal with instruments in his external meatus. He had in childhood a discharge for a long time, as the result of a shot directly at the left ear. At present for a week profuse discharge and tickling in the right ear. Osseous meatus and drum-membrane of the right ear covered with dirty gray-brownish streaked masses. Under the microscope mould mycelium, with numerous small heads of aspergillus fumigatus. The drum-membrane diffusely reddened; isolated small places surrounded by round white areas of epidermis, resembling small burst bubbles. Left ear: posterior lower quadrant occupied by a cicatrix.

August 8th.—No formation of mould visible.

Case 39.—Miss B., æt. 63 (?) (cp. history of case). Returned September 16, 1886. She has suffered since from frequently relapsing inflammation of the external ear, with swelling of the cartilaginous meatus. The last months tickling persists, and

"ulcers" are formed. At the bottom of the left ear secretion and dirty cheesy masses are found, which consist for the most part of delicate mycelium, with partly gnarly outgrowths without fructification. Very small, colorless conidia, partly arranged in rows, float in the fluid. Patient denies having lately instilled oil.

Until September 22d, treatment with salicylic acid is continued. No mould elements are found. On the other hand, there are still a discharge and strong fetor. Treatment with boric acid is therefor now substituted (injection of a 4 % solution of boric acid, and, after drying, insufflation of boric acid), whereupon both fetor and discharge disappeared by September 27th.

November 11th.—(Last examination.) External meatus dry and free from inflammation.

CASE 40.-J. R., æt. 19.

Otomycosis dextra. A year ago discharge from the right ear, tinnitus, and hardness of hearing.

November 8, 1886.—The same symptoms, and, as formerly, without pain. At the bottom of the external meatus dirty yellow masses, which contain when removed with the syringe much delicate, partly-disintegrated mycelium, with isolated, distinctly pear-shaped fructifications of verticillium. Instillations of oil had not preceded. On the 20th: external meatus normal.

CASE 41.-G. L.

Fanuary 5, 1886.—Hardness of hearing in the left ear for years. Last five weeks, instillations of oil. For four weeks impairment of hearing, tickling in the ear, slight pain, and a discharge. Left drum-membrane covered with dirty yellow masses, which contain under the microscope spores that have fallen off, and of mycelium of verticillium, with indistinct outlines filled partly with fat globules. The drum-membrane appears, after cleansing, dark and diffusely injected.

CASE 42.-V. A.

April 13, 1886—Middle of February swelling at first in the right, two weeks later in the left ear, and hardness of hearing. For four weeks tinnitus, on account of which injections into both ears, and instillations of oil. At present, tickling and tinnitus. From the right meatus a small whitish, from the left a larger grayyellow, glove-shaped membrane are removed, both consisting exclusively of mycelium and fructfications of aspergillus fumigatus. Slight excoriation of the right external meatus; drum-membrane covered with a whitish layer.

CASE 43.-H. H., æt. 40.

Fanuary 9, 1884.—Bilateral otomycosis. For two years, frequently, discharges and hardness of hearing, alternating in either ear. A year and a half ago, instillations of almond oil. At present, secretion in the right ear, from which mycelium, isolated colorless small spores, and fat globules are removed with the syringe. For two weeks continuous tinnitus. Both drum-membranes dull and lustreless.

Fanuary 23d.—Tinnitus still continues, meatuses free.

CASE 44.-Z., æt. 44.

Fanuary 18, 1884.—For two years bilateral intermittent discharge, with slight tickling in both ears. Meatuses narrowed by diffuse swelling. Numerous whitish shreds, removed with the syringe. The removed pieces consist of epidermis, and an occasional round-cell, and a few bacilli. Drum-membranes not visible, on account of a collection at the bottom.

Fanuary 23d.—Numerous yellow-streaked epidermis lamellæ are removed with the syringe. These contain mycelium, with gnarly outgrowths and isolated small heads of aspergillus fumi-gatus.

February 6th.—Tickling still continues; thick, white epidermis lamellæ are removed with the syringe from both ears, which prove to be free from mould elements. Drum-membrane normal; also on February 15th.

CASE 45.-E. W., æt. 50; from the country.

May 6, 1884.—Damp dwelling-place. For 1½ years hardness of hearing and itching in the ears. For three months frequent instillations of oil. The cartilaginous and osseous parts of the meatuses swollen, at the bottom yellow masses. Gray-yellow, somewhat mucous, odorless masses are removed with the syringe, which masses contain cocci and verticillium elements. The mycelium encloses numerous fat globules.

May 7th.—Extensive formation of epidermis. The masses no longer contain mould elements. Swelling decreased.

May 11th.—Cured.

CASE 46.-K., æt. 29; gardener.

November 18, 1884.—Bilateral otomycosis. For a year frequent bilateral discharge and itching. No instillation of oil. Dirty yellow, extremely fetid, moderately soft mass in the cartilaginous and osseous meatus. Large masses of bacteria in the secretion, besides in the left ear delicate mycelium. On the right ear, at isolated places, numerous conidia of verticillium.

By November 28th.-Cured.

• January 19th.—Patient presents herself again, with a complaint of reappearance, a few days ago, of itching and discharge. Injections, however, removed epidermis only, without moulds.

Fanuary 23, 1885.—Meatuses normal.

CASE 47.-St., æt. 38.

April 4, 1885.—Bilateral otomycosis. For two years bilateral tickling and occasional discharge, slight pain and swelling. In the right meatus there is a deposit on the wall between the cartilaginous and osseous part. It consists of small white conidia, arranged partly like strings of pearls and in groups, and also isolated, dried, small, short, band-like hyphens. Left meatus (not carefully examined) narrowed by quite extensive swelling.

By April 14th.—The swelling of the meatus has subsided, and the unbearable itching in the meatuses, which had lasted almost uninterruptedly for two years, has entirely disappeared.

CASE 48.-Z., æt. 33.

Fuly 6, 1885.—Otomycosis of the right ear. For years much tickling. Patient frequently removed odorless masses from the meatus, which had a cheesy, whitish appearance. Oil was never instilled. Patient is troubled with a hypersecretion of sebaceous matter (seborrhæa). Osseous meatus reddened, excoriated, and narrowed by swelling. In the removed masses much gnarly mycelium inclosing fat globules and colorless spores.

By Fuly 13th.-Cured.

Patient is a brother of the above-mentioned Miss Z., case 44, but they do not live in the same house. In both the same gnarly mycelium was found.

CASE 49.—Maj. H.

Fuly 24, 1885.—Patient lives in the country. Otit. exter. dex. (bacterial); tickling since last winter. Lately slight pain in the cartilaginous part. At the bottom yellowish masses. Patient has made many injections of water and instillations of oil. The masses consist of epidermis, the film of most delicate fibres (leptothrix?), and masses of bacilli and cocci.

Fuly 28th.—Cured by treatment with boric acid.

September 22d.—In the left ear for two weeks tickling, for six days discharge, and swelling of meatus; white, on one side brown, lamellæ, containing an immense number of cocci, bacilli, and numerous fructifications of a small aspergillus, are removed with a syringe.

October 5th.-Cured.

The mould was, according to my examinations, a beautiful specimen of aspergillus nidulans; many old, but no young, fruitbearers, most of them red-brown, with sterigmata. Conidia free.

CASE 50.-W. V., æt 31; from the country.

October 8, 1886.—Bilateral otomycosis. For three years frequently recurring inflammation and discharge of short duration, with tickling, tinnitus, stinging pain, and swelling. Patient had each time made instillations of oil and soap-water. Small pieces of "skin" have frequently been discharged. The removed masses contain nothing but gnarly mould mycelium, without fructifications. Both drum-membranes appear intact.

October 9th.—Meatuses still slightly swollen. No discharge.

CASE 51.- J. E., child (æt. ?).

November 14, 1884.—Deaf-mutism following meningitis, nine months ago. Right drum-membrane cannot be examined, on account of an artificial eczema caused by the instillation of an irritating substance. Left meatus filled by dirty gray membranes, which show, when removed with syringe, a blackish deposit upon one side. This consists of elements of aspergillus fumigatus. Repeated instillations of almond oil had preceded six months ago. The drum-membrane, after cleansing, shows granulations in its lower half.

CASE 52.- J. K., æt. 27; miner.

December 8, 1883.—Bilateral hardness of hearing, of varying intensity, for three years. Patient had formerly, and for the past month, instilled ear-oil. Intense tickling in both ears. In the right ear, in the osseous meatus, and on the drum-membrane dry brownish crusts are situated. The drum-membrane, after their removal, appears very white and, together with the handle of the malleus, very diffusely reddened. In the left ear, in the posterior lower quadrant, fresh extravasation of blood. In the osseous meatus no excoriations; epidermis also thickened, forming regular streaks.

The crusts consisted of numerous fructifications of mucor corymbifer. The specimen is fully described in the following section of this paper.

The following case is appended on account of its great botanical interest, although it did not occur during the period 1881 to 1886.

CASE 53.—F. Z. had been treated in June 1884 by Prof. Bezold for bilateral residues of otitis media after scarlatina. In the right ear extensive double perforation in the anterior and posterior half. Both perforations separated by a narrow scar running from the handle of the malleus downward. In the left ear the lower half occupied by a scar, the upper by calcification in front of and behind the handle of the malleus.

June 19, 1887.—Patient returned on account of a suppuration which had developed in the right ear five days ago, with much pain. A lamella of epidermis with brownish spots and a large croupous membrane were removed with a syringe. In the former a delicate mycelium with colorless fructifications, "similar to those in penicillium." Examination of the right ear: the bridge between the two perforations no longer visible. Bleeding granulation at the margin. Condition of the left ear as in 1884.

The blackish spots consisted, according to my examinations, of fructification of a penicillium. Its full description follows below, (p. 251).

#### I .- BOTANICAL PART.

I.—BUTANICAL PART.	
a. Exactly determinable were the moulds in 36 patients = of the entire number. The majority of these specimens were still present at the time of my examination.	69 %
b. Not determinable were the moulds in 16 patients = of the entire number. In some of these only mycelium existed, in others conidia and mycelium. The 36 exactly determined moulds belong to:	31 %

Verticillium Graphii Harz et Bezold, 7 cases (20

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24, 29, 40, 41, 45, 46) =19.44 % of these, 4 were bilateral.

Mucor corymbifer Lichth., 1 case (52) bilateral = 2.78 % septatus Bezold, I case (2).

Not determinable were cases 3, 5, 9, 15, 19, 22, 23, 27, 28, 33, 36, 39, 43, 47, 48, 50, 51; of these, 4 cases were bilateral (3, 9, 43, 50).

In the appended case (53) a very small penicillium was found in the ear during a violent inflammation, which on account of its slender structure and its faculty of growing in the ear-viz. at 98° F.-should be distinguished from penicillium glaucum, and which I would call penicillium minimum. The specimen had the following appearance: On the removed membrane blackish spots can be seen at places; when scraped off they appear under the microscope as groups of small rounded conidia which are partly budding and cling to one another by their freshly germinated tubes. When isolated they appear plainly outlined, colorless, and in thick, dark-brown layers (of the color of asperg. niger). The delicate-branched colorless mycelium is septate (diam. The fruit-bearers end neither in solid nor in hollow nodules, but resemble completely those of penicillium glaucum. The total length of the pencil (without conidia) amounts to circa, 20µ; they septate at distances of ca.  $6\mu$ . The spherical smooth conidia have a diam. = 2.5— 3µ. In addition in each specimen, groups of crumpled, otherwise round, transparent, brownish cells are found, each of ca. 20μ in diam. (Sclerotia, zygospores, or impurities?).

This is the first reliable observation of the pathogenic action of penicillium. That they really grow in the ear, and that the fructifications found were not accidentally introduced, is proved by the subjective and objective symptoms, and also by the fact that between the masses of epidermis in the specimen quite an amount of young and old mycelium and of germinating conidia were found. Prof. Bezold at the first examination had recorded this mould as "penicillium-like."

252

Another discovery is the occurrence of aspergillus nidulans in the ear (cp. fig. i. plate I.). Both specimens contain a number of the characteristic conidia bearers, which were compared kindly with a pure culture which Prof. Eidam, of Breslau, had sent me. This mould was first described by Eidam in the Beiträge zur Physiologie der Pflanzen, by Cohn, vol. iii., No. It was until now of no otological importance, and at any rate unknown to aurists. Eidam found it upon the nest of bumble bees in the botanical garden of Breslau, and cultivated it upon Cohn's nutrient fluid and upon a decoction of manure. It grows best at a temperature of 38°-42° C. (100.4°-107.6° F.) and fructifies at this temperature after 20 to 40 hours. The turf develops in the same manner as in the other aspergilli; the white mildew growing from the centre to the periphery when fructifying takes first a light gray, then a chrome-green, at last a dirty-green color. The fruit-bearers are frequently branched, and then bent; Eidam designates them as dwarfs as compared to the aspergillus niger. Those of the first generation are 0.6 mm to 0.8 mm long and  $8\mu$  to  $10\mu$  wide. The receptacle is not round, but appears as a club-shaped, colorless or yellowish, later a brownish end-swelling of the same colored hyphen, being at the most twice as thick as the latter. The top of the receptacle in the ripe fruit is frequently cup-shaped, sometimes as though torn off so as to produce the impression of looking into a funnel from above.

The sterigmata cover only the top of the club. They are less colored than the receptacle, more slender and longer than the sterigmata of the aspergillus fumigatus; they are branched, but show at the utmost two or three small branches. The mass of the sterigmata appear at the head, on account of their branching which as such easily escape detection, as consisting at places of two concentric layers, of which the inner lower, mostly darker-colored, contains the simple sterigmata, whilst the outer and brighter one contains the lancet-shaped branches. This picture is well known to one familiar with asperigillus niger, in which it appears much more beautiful and more distinct. The conidia are spherical, small  $(3\mu)$ , colorless or light brownish,

and when detached from the sterigma firmly cling to one another in chains and chain cords (fig. i., d and e).

In addition to these conidia-bearers permanent fruitsperithecia-are found, with asci containing spores. They are placed like nests in a peculiarly shaped envelope into a light-yellowish layer of single-contoured, gnarly, anastomosing hyphens, the numerous end-branchings of which represent round or oval and-with the exception of the place of insertion-double-contoured, very thick-walled receptacles.

The fully developed receptacles have a diam. = 16 to  $19\mu$ ; the thickness of their wall may amount to  $4\mu$ . appear under the microscope very bright when single, bright yellow in thicker layers. The fruit-body proper of the perithecium forms under the magnifying glass a small ball, which can easily be removed from its capsule, and which has in the ripe state from 0.2 mm to 0.3 mm diam. The asci develop irregularly at an early stage; the wall of the fruit-body becomes, when ripening, dark purple, then black. After ripening the asci also assume this purple color, which finally gathers in the ascospores. (The development of the perithecium is, according to Eidam, very slow, and lasts many weeks until its entire completion.) The asci are ovoid, 10.5 to 11 µ in diam., and are found placed on short hyphens associated with one another in all stages of development. The ripe spores, 8 in each ascus, are nearly oval, smooth, with a strong purple-colored external membrane; diam. =  $51.4\mu$ . Germination takes place as in the spores of Eurotium repens and glaucus, during which their purple color changes to violet. It is noteworthy that the first rudiments of the fruit-body turn blue with a potash solution, and red with acetic acid. Intravenous injection of the conidia has a pathogenic effect.

Three years later a paper on the same subject was published by Lindt (Communications on Some Path. Moulds, Arch. of experim. Pathol. u Pharmakologie, 1886). Lindt cultivates the aspergillus nidulans upon I % bread agar in the incubator at 98° F. His description agrees, on the whole, with that of Eidam.

I have very little to add to the above description. In the

masses removed from the ear of H. (case 49), almost half of all the receptacles were entirely denuded. Sterigmata and conidia are, for the greater part, frequently still in situ, somewhat swollen, and thus not very distinct. The riper conidia are in thick layers, yellow, dirty-green-brownish, or light-brown. The bright-arched zone, which in aspergillus niger is well marked between the sterigmata of the first and second order, is found only in young specimens, and then only after long search. The sterigmata are too light-colored to make the colorless septa appear well marked.

Aspergillus nidulans is distinguished from aspergillus fumigatus, not only by the sterigmata which in the ripe are brighter and much longer, but also by the loose attachment of the latter in this stage. The darkest receptacles therefore have frequently a naked vertex, whilst in fumigatus it is usually covered by a densely bristled cap. Furthermore, the receptacles and fruit-bearers of nidulans have a brownish, those of fumigatus a smoke-gray color. In the specimen taken from the ear the fruit-bearers had an exquisite reddishbrown, which color was also found in pure cultures upon sterilized bovine serum. Whilst I can confirm the botanical communications of Eidam and Lindt, I would like to add that according to my examinations and cultivations the spores arising from the perithecia are neither oval nor round, but that they have the lentil shape of the Eurotium spores, and that they have like these a rather deep circular furrow at their sharp margin corresponding to their largest circumference. They appear therefore when viewed from the surface entirely circular; but when viewed from the margin they offer the picture of a spindle, both of whose poles are somewhat indented.

I dwell upon the latter picture somewhat longer because I believe that the perithecium of aspergillus nidulans has been found before in the ear, and that it is identical with the obscure otomyces purpureus Wreden et S. M. Burnett. These authors describe in their respective cases (Archiv f. Ohrenheilk., vol. iii., No. 2, and these ARCHIVES, vol. x., p. 318) the following structure: Masses resembling blood-clots, which formed during acute inflammatory symptoms, and consist of

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delicate (diam. = 5.7 to 7.0 $\mu$ ) branched and septate doublecontoured mycelium. The latter bears round, thick-walled receptacles, "sporangia" (Wreden), or "asci" (Burnett), of 21 to 64 \mu in diam. These are pale-yellowish, and without contents, or purple-red and with spores. The free ripe spores are larger than the enclosed spores, with frequently divided, nuclear structures, round purple-red; diam. = 2.9 to 4.3 $\mu$ , and when germinating 7 to 8.5 $\mu$ . The red coloring matter was exclusively confined to the asci, but appeared scattered in the older portions throughout the entire mass. Even the epithelial cells were beautifully and equally colored by it. Wreden subsequently saw an aspergillus grow from this mass, with dark small heads, which he thinks is asperillus niger, and therefore considers otomyces purpureus as the permanent fruit of aspergillus niger, in which view he is supported by the botanist Waronin, of St. Petersburg. Prof. Farlow, of Harvard University, on the other hand, justly denies the identity of Burnett's mould with aspergillus niger, and decides that otomyces is an entirely new or an, up to that time, incompletely described Eurotium, which view is accepted by Burnett.

As can easily be seen, Wreden-Burnett's description on the one hand, and Eidam-Lindt's on the other, do not agree in all their details. But the difference is so slight and the description is on the whole so similar as to make me willingly change my former attempt at explaining this description (cp. "Die Fadenpilze," etc., Wiesbaden, 1883, p. 53) for the above more intelligible explanation. It is more doubtful whether the aspergillus nidulans is identical with the mould which Gruber found in the ear (Monatsschr. f. Ohrenheilk., September, 1870), and which was described by Prof. Karsten as being very small, half as large as aspergillus fumigatus, with club-shaped receptacles, and awl-like, upwardturned sterigmata. Dr. Orne Green described an aspergillus rubens at a meeting of the Boston Society of Medical Sciences (November 19, 1868). I regret that I did not succeed in gaining access to a full description of it. pathogenic property of the aspergillus nidulans discovered in 1883 is, according to the above communication, really of

practical importance. That this aspergillus is comparatively not infrequent, and that after careful search and right judgment of the characteristics distinguishing it from fumigatus, it will certainly in future be still more frequent, is proven by the fact that among the above-described cases it reaches the percentage of aspergillus flavus, viz., 5.56 %.

Aspergillus flavus played a much more important part in former reports on otomycosis than now. Wreden ("Die Myringomykosis aspergillina in den Jahren, 1869–1873"; Archiv f. Augen- und Ohrenheilk., iv., p. 87) reports that among seventy-four cases of otomycosis aspergill. he has seen the aspergillus "flavescens" twenty-four times (i.e., in almost 33% of all cases). Prof. Bezold ("Ueber Otomycosis," lecture delivered before the Ærztliche Verein of Munich, 1880) found among forty determinable moulds taken from the ear "flavescens" only eight times (i.e., 20% of the cases). C. H. Burnett, however, reports in 1879 (twenty cases of aspergillus, Amer. Fourn. of Otol., 1879, vol. i.) that he did not find the "flavescens" in one of his patients suffering from otomycosis.

The frequency of aspergillus niger shows a similar relation. This can probably be accounted for by the fact that the small forms of moulds give on the whole less cause for an examination of masses removed from the ear in which moulds are suspected. Wreden found the asperg. "nigricans" in ca. 66 %, Burnett even in 100 % of all their cases of otomycosis. Bezold recorded, in 1888, 11 cases of niger (among 40). Our record of 19.44 % does not materially differ from these two figures; there is, at any rate, a slight decrease to be noticed.

Prof. Bezold first called the attention of aurists to the occurrence and to the comparative frequency of asperg. fumigatus in the ear. In his statistics of 1880 he states a frequency of 18:40=45%, a proportion which almost entirely agrees with that of our synopsis, in which fumigatus figures with 44%.

Before I enter into the discussion of other moulds, I should like to speak first of the present nomenclature of aspergilli. Flavescens and nigricans of Wreden have been

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recognized as independent species, and as identical with asperg. flavus Bref. and with niger van Tiegh, respectively, according to my culture experiment with asperg, niger taken from the ear, comparison of measures recorded by the authors, and also according to comparison of the specimens of flavescens and nigricans found in otomycosis with the specimen of Rabenhorst's mould collection. therefore be desirable that the former denotations be entirely given up by physicians. The aspergilli niger and flavus are found as such embodied in Rabenhorst's mould collection; they are described as such in Winter's standard work, and no expert botanist recognizes, in addition to these, a special aspergillus flavescens or nigricans. be better to call them aspergillus niger van Tieghem and aspergillus flavus Brefeld. The names A. nigricans, nigrescens, and flavescens have no title in scientific botany.

With the large percentage, 19.44 (the same as that of A. niger), we furthermore find in our statistical synopsis a verticillium recorded. Profs. Harz and Bezold thus call a mould which—not identical with any botanically known mould—was first described as a rarity by Hassenstein and Hallier, and a year later by Steudener, and which was also found three times in the ear by Prof. Bezold as early as 1870 to 1879. Prof. Hassenstein, in the Archiv f. Ohrenheilk., vol. iv., p. 162, under the heading, "Beobachtung eines neuen Pilzes, des Graphium penicilloides im äusseren Gehörgange, von Medicinalrath Dr. Hassenstein in Gotha, mit Nachtrag von Prof. Dr. Hallier in Jena," gives an extensive history of a case.

F. Steudener (Zwei neue Ohrpilze, Archiv f. Ohrenheilk., vol. v., 1870) describes a mould found by Prof. Schwartze in the ear, which there had produced symptoms; "these were entirely identical with those already known as arising from aspergillus growths in the ear."

Hallier's stemphylium, Steudener's trichothecium, and also Harz-Bezold's verticillium are apparently identical. This view is supported by such descriptions as exist, by the illustrations, and by the specimens. But concerning the graphium? In no single case of otomycosis have several

forms of moulds been simultaneously found alongside of one another. And still these stem-like structures have not only been found once, but regularly associated in all the specimens of Prof. Bezold, which he formerly considered, with Steudener, as trichothecium, later (according to Prof. Harz' statement) as a mixture of graphium and verticillium. For a long time, however, he believed these moulds to be identical just on account of this occurrence.

I had the finest of these specimens drawn; it is taken from the patient, M. A. (Case 29, cp. fig. ii., plate 1.).

Under the cover-glass there are six small flakes, each of which consists exclusively of a light-yellow mould-mass. On the margin are the delicate, almost colorless fruit-bearers; in the centre of the flake is the mycelium, which is about  $3\mu$  thick, double-contoured and septate, slender, branched, and partly containing fat; in addition there are brown older elements. Oval spores are irregularly scattered over the field of vision; the bright ones hang on the fruit-bearers; large, darker, double-contoured ones, which have fallen off, are principally found in the centre of the mould-flake.

The fruit-bearers (fig. ii., b) are mostly colorless or light-yellow, with delicate walls, and exhibit the character of a straight stem. From this, at short distances, and at an upward acute, or at about right angles, longer simple or branched twigs are given off, which stand at places in pairs and opposite to one another, more frequently alternating or entirely irregular. Each twig-end bears as a prolongation a spore. In the stem formation (fig. ii., a) we find longitudinally fibred bundles, measuring from  $3\mu$  to 0.3 mm, which, at their upper free end, divide like a broom. Their single fibres are not distinctly septate, but in their other respects correspond to the mycelium of the verticillium.

It is characteristic of the biology of verticillium that of seven cases of otomycosis with fetid discharge, we had to deal with verticillium four times. More than half of all the seven cases of verticillium grew on disintegrated nutrient soil. Still that this is not easily cultivated is demonstrated by a case in which I removed in the winter of 1882-'83 "verticillium and graphium elements." Not knowing them at that time I sent them to Prof. Bezold, whom I consider

an authority on moulds and who was kind enough to determine them botanically. In the meantime I made pure cultures with the fresh material upon granulated sterilized blood-serum and upon 10 % gelatine. The mould did not grow upon the former; upon the latter a white, downy turf with a slightly-yellowish tint developed in the incubator at 37° C. in about four or five days, which showed under the magnifying glass only slight mycelium, but numerous vertical fruit-bearers similar to those of the verticillium taken from the ear, but much stronger and longer. At the periphery macroscopically no lying, creeping, or radiating threads were noticeable, as they are found in all aspergilli, eurotia, and also in most of the mucorineæ under favorable conditions of temperature and nutrition. Under the microscope this growth really proved to be a pure culture of verticillium: strong, pale, very long fruit-bearers with many strong branches, and numerous large and pale spores. "Graphium penic." was not found, although it had been abundantly present in the original specimen.

I regret that I used the entire culture for microscopical specimens before it had assumed a darker color and the conidia had ripened, in the belief that the remaining mycelium might produce new fruit-bearers. At this place, however, no new growth developed, and no case of this kind has since occurred in my practice which offered an opportunity of continuing these pure cultures, of examining the germination of spores, the growth and biology of this mould more carefully, eventually of making some experiments on animals with the spore material. As a probable result of this experiment it appeared to me that the "graphium" is not a mould sui generis, but only a stem-formation of the fruit-bearers of verticillium; this is also found in certain other hyphomycetes as e.g., as a rule, in the Isaria (cp. de Bary, "Morphologie und Biologie der Pilze"). Another argument for this view is the fact that the ripe spores of graphium and verticillium are exactly the same; the hyphens themselves have also the same color and dimensions. The third argument for our assertion has been mentioned above, viz., that these two forms of mould are always found

in conjunction in the same ear. Prof. Bezold, in spite of his large relevant material, does not know of any case in which two acknowledged species have been found together in the same ear. There is not even a case known in which in bilateral otomycosis a different species was found in each ear.

Prof. Harz also considers the removed masses and my pure cultures positively as verticillium, and holds that this form does not correspond to any of the known species of this genus. We propose therefore to embody this mould into its proper genus and call it once for all verticillium, with the addition graphii, in consideration of its stemformation having been confounded by its first discoverer, Hallier, with the graphium.

The botanical description is therefore briefly as follows: Verticillium graphii Harz et Bezold. Stemphylium polymorphum Bon (?) + Graphium penicilloides Corda (?) Hallier. Trichothecium roseum (?) Steudener.

Hyphens of thallus transparent, colorless, later thick-walled, yellow to brown, septate, branched. Diam. = 2 to 3µ. The fruit-bearers mostly somewhat lighter at larger distance, delicately septate, straighter, and somewhat thinner than the mycelium. Branches in pairs and opposed to one another, frequently given off irregularly, often branched again. Spores isolated at the end of the branches tapering towards the fruit-bearers, when ripe, smoke-gray, ovoid, with smooth surface. (Diam. = 5:3µ.) Bundle-shaped mycelium-cords and stemformation, with normal formations of conidia, very frequent.

The two specimens of *mucor* made me search otological literature for cases of this kind. Tröltsch incidentally mentions in the second edition of his book, in the chapter on otitis externa, an "ascophora elegans" found by him in the ear. Dr. Jul. Böke (*Monatsschr. f. Ohrenheilk.*, 1869, and *Ungar. med. chir. Presse.*, 1868) reports the following history:

A woman, æt. 28, who had never before had an ear disease, gradually became deaf, in November, 1868, without pain, after she had, on account of a laryngeal trouble, made frequent instillations into the ear. White pseudo-membranous mould-masses were removed from the meatus, and again a week later drops of

acetate of lead finally effected a cure. The mould proved to be a mucor ("mucor mucedo") with pear-shaped enlargements of the ends of the hyphens, which contained spores.

More exact description is wanting in this case. Since the spores of mucor mucedo are in reality not pear-shaped but round, Böke's mould is perhaps rather identical with the following mucor corymbifer (Lichtheim).

A Hückel published in 1884 a case of otomycosis mucorina in a dissertation: Contribution to the Study of Mucor Corymbifer (Beiträge zur pathologischen Anatomie und Physi-

ologie, by Ziegler and Nauwerk, Jena, 1884).

From the introductory notes of his paper we emphasize the following: Mucor was positively found twice in the lungs of man. In both cases a small form with branched fruit-bearers and smooth sporangium membrane (Fürbringer, Virchow's Archiv., vol. lxvi.) was present. Lichtheim, of Bern, published in 1883 a careful paper, upon two new kinds of mucor, which is pathologically and botanically extremely interesting. He calls them mucor rhizopodiformis and corymbifer. The latter was found by Hückel in a cerumen plug, which Prof. Wagenhäuser had removed from a patient, 27 years of age, suffering from tinnitus and tickling in both ears, and had left to the former for examination for moulds.

The examination of the patient revealed in both meatuses, between inspissated, dark cerumen, gray-white masses, filling the entire lumen, in which macroscropically vertical threads and dark small heads could be recognized. After removal the walls of the meatus and of the drum-membrane were found loosened and intensely reddened. Treatment-sublimate alcohol. No The plug, of the size of a pea, contained in a white relapse. filter-paper-like mass, dark-brown spots.

The description of mycelium and fructification offers a slightly different feature from the typical picture of m. corymbifer, inasmuch as in this specimen no corymbiate but only dichotomous fruit-hyphens were found, and also large brown, more or less roundish structures, with thick walls,

<sup>&</sup>lt;sup>1</sup> On Pathogenic Mucorineæ and the Mycosis Produced by Them in Rabbits, Zeitschr. f. klin. Med., vol. vii., 2.

connected with the mycelium, which contained thickly granular protoplasm with a few fat globules, and made the impression of zygospores. Culture and inoculation experiments proved in this case the identity of the mould with the mucor corymbifer Lichtheim.

In the specimen (microscopical only) of case 52 numerous fructifications and a small amount of mycelium of a mucor were found, which was apparently also identical with the above-described one, but at any rate showed *in toto* somewhat smaller dimensions:

The spore-bearers are colorless 3-7 $\mu$  in thickness, stretched at places with furcate twigs, and aseptate.

The ripe sporangium is club-shaped, yellowish, with transparent, smooth, delicate membrane. Diam., varying, reaching 35 \mu. In the larger ripe specimens, the top is mostly found, at the equator or lower down, to be irregularly torn off in shreds; at the bottom of the remaining cup-like lower half, spores, but no columella, are visible. Where the columella is visible, it is colorless, transparent, with a convex top. The remaining wall of the sporangium is closely attached to the usually conoid, sometimes hemispherical lower half, which gradually passes into the bearer. In addition, isolated dwarf sporangia are present. spores are in toto oval, diam. =  $2-3\mu$ , colorless, in thickened layers slightly yellowish. Where they were exposed to glycerine(preserving fluid) they were somewhat shrunken and appeared angular. The greatest part of the mould-mass is entirely enclosed by brown oil and therefore the course of the mycelium and the sporangium-bearers cannot be distinctly made out. Furthermore, this fluid might have somewhat changed the usually darker color of the contents of the sporangium.

I enter now into the description of another noteworthy, vigorous mucorinea, found among our cases, which, when magnified 100 times, can easily be recognized in all its details, and which was found in case 2 in large masses.

## Mucor Septatus Bezold.

The mycelium is colorless, little or not at all septate, at places with spindle-like swellings. The ripe sporangium-

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bearers have a diam. = Ca,  $10\mu$ , a light- to chocolate-brown color, thick walls, which show some dark, gland-shaped or oval, slightly thickened spots, apparently towards the lumen of the bearer. The branches are mostly in clusters; less frequently at the top a corymb of three to four short sporangium-bearing twigs is found. Lower down the main stem, usually where several branches are given off close to one another, appears to be abruptly swollen like a club, and of a darker color, with the above-mentioned gland-shaped spots, and with root-like or warty, colorless or brown bulgings of the wall. Spur-like processes are found as an exception farther up at the fruit-bearers. The sporangium-bearers are septate; strong septa are rarely missing, especially near the branchings and the sporangium. The bearer widens above, towards the insertion of the sporangium. The sporangium itself is of a pale, brownishyellow color, spherical, with transparent membrane, and smooth or slightly mulberry-like surface. Diam. =  $32\mu$ . The spores fill the entire space down to the apophysis between sporangiola (sporangium-membrane) and between the at first small, light, colorless columella, and cover the latter from above and from the sides, in such a way as to make it only visible from below. There are comparatively very few sporangia still preserved. Most of them have been probably destroyed by the injections of water into the ear.1 The columella apparently develops further after the loss of sporangiola and spores, then appears brownish, of the color of the sporangium-bearers, slightly oval or spherical, not tapering towards the base. The lower pole is somewhat flattened, so as to make the walls of the columella and sporangium-bearer pass into one another, with sharply defined, at places even rectangular bending. At this junction the remnant of the torn-off sporangium-membrane is frequently found as a very small circular ruff. Diam. = 27μ. A number of the older columellæ are crumpled, torn in shreds, with a top flattened out, whereby the columella appears like an umbrella, a mushroom, or a head of a nail

<sup>&</sup>lt;sup>1</sup> In a large number of the known species of mucor, the sporangiola (enveloping membrane) bursts when water is poured upon it, and dissolves, so as to set free the spores and columella.

(fig. 3, d and e). The spores are light-yellow or slightly brownish, smooth, spherical, or slightly oval. Diam. = 2.5  $-4\mu$ .

This mucor is not identical with any of the known species. It bears a striking resemblance to rhizopodiformis Lichth.: root-like structures, at places spindle-like swelling of the mycelium, round small heads with broad apophyses and round spores. On the other hand, M. rhizopodiformis has black sporangia, columellæ like an inverted jar, aseptate, and sporangium-bearers, mostly without branches, and considerably larger spores. The latter condition holds good also of M. stolonifer, the spores of which have a diam. of 10–20 $\mu$ . M. pusillus Lindt has, like rhizopodiformis, columellæ, slightly tapering towards the apophysis. The membrane of the ripe sporangia is thistly, the fruits are placed upon a single bearer, or at the utmost upon one fork, with equally long branches.

Rhizopus Link has very large (II: 15 $\mu$ ) and markedly oval spores and vesicles of II2-I80 $\mu$ . Mucor ramosus Lindt and corymbifer Lichth. have pear-shaped sporangia, and are therefore left entirely out of consideration. The absence of the septa in M. rhizopodiformis, which botanically is nearest to our mould, called forth the denotation of M. septatus. Our mould shows in all parts such typical, vigorous forms that it can hardly be considered as a stunted variety of another species. Culture experiments, which are the only proof, are wanting. We shall call the mould mucor septatus, until its pathogeneity has been demonstrated.

It is known that the moulds assume atypical forms under unfavorable nutritive conditions, and remain small, producing only mycelium, without fructifications. We frequently find a very young growth which has not as yet fructified. It is therefore all the more desirable to make in each doubtful case culture experiments for the determination of the identity of the vegetable parasites. For this purpose, a part of this mould-mass should be rapidly dried, at a temperature of ca. 30° to 50° C., preserved in a dry state in a sterilized test-tube, and the other half placed in a preserving fluid.

The culture experiment can be simply made in the following manner: First, heat needle and forceps to a glow, clean the hands with carbolized water, and soap the glass plate, stool, and bell in the well-known manner in sublimate water, subsequently pour over alcohol and ether, cover the bottom of the plate with filter paper which is imbued with well boiled water; then place upon the stool, which rests upon the filter paper, a roll freshly baked, rapidly washed in sublimate water, and divided with a sterilized knife. Upon the cut surfaces of the roll which look upward, we rub energetically and extensively the masses taken from the ear, cover them well with bell or plate, and place this apparatus in winter-time near the oven, wrapping it up at night in flannel to prevent cooling of the culture. After one to two days we moisten the bread once more with well-boiled water and keep the filter-paper cover moist. Still simpler is the culture upon a thick bread-pap (bread-decoction) in Erlenmever's flask.

If we have all the apparatus, we may sow another part of the mass taken from the ear upon sterilized, slightly acid, 10 to 15 % solution of gelatine, or upon bread-decoction-agar, spread it well with a platinum loop brought to a glow over the sterilized plate or flask, and then bring it as it is described above under the moist bell-jar, which should be kept warm. Malignant moulds develop as early as in 36 to 48 hours and at lower temperatures in about twice that time, so as to enable us to distinguish them macroscopically or with the magnifying glass. At any rate the microscopic examination should not be neglected, for which a magnifying power of from 200 to 300 should be used.

#### II.—CLINICAL PART.

Occurrence and Etiology.—In my former synopsis (cp. Fadenpilze, 1883) of Burnett's, Wreden's and Burckhardt's cases,  $\frac{1}{4}$  occurred in the first half of the year and  $\frac{3}{4}$  in the second. This peculiar disproportion is not found in this

<sup>&</sup>lt;sup>1</sup> The author will be very much indebted to those of his colleagues who send masses in which moulds are suspected and which have been taken from the ear, and he will be very glad to furnish them with information upon the result of the examinations.

synopsis, since the 52 cases are almost equally distributed over both halves of the year. Most of the cases were treated in January and September. The season, therefore, appears to have no influence whatever upon the occurrence of otomycosis. Among the patients

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The observation, first made by Wreden, of the rare occurrence of otomycosis among children until the fifteenth year of age, is thus confirmed. In this synopsis adults from 16 to 20 years do not frequently suffer from otomycosis. It is a remarkable fact that among our 52 cases, country-people and gardeners are frequently affected. They comprise of 15 cases, 29 %, whilst hardly more than 10 % of all ear patients treated during the same period belong to this class. The statistics prove the contrary of the assertion of others, that the country population suffer more from otomycosis on account of their being exposed to direct sun radiation, to heat and perspiration.

There is a great discrepancy of opinion between authors as regards the *frequency of otomycosis in general*. Whilst Bezold stated, as late as 1880 (cp. lecture delivered before the Medical Society of Munich), that of 65 patients I had otomycosis, we find in the entire number of 8,272 patients treated from 1881-1886 only 52 cases of otomycosis = 1:159 = 0.65 % (i. e., from 1881-1883 = 0.7 %; from 1884-1886 = 0.6 %). During the years 1872-1880 there was I %.

It is improbable that, as can be seen from this large statistical material, the difference of the figures and the gradual decrease of the frequency of otomycosis is purely accidental. This depends, probably, upon the less frequent application

of oil instillations, against which aurists have warned lately. Their dependence upon local causes is also proved by the fact that in two years six cases of otomycosis came under my treatment in the mountain village of Klosters though it had but a very small population. This is a remarkably high figure, since it comprises at any rate 5 % of all ear patients treated during that period.

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The other authors report a small percentage of frequency. According to Bürkner (Contribution to the Statistics of Ear Diseases, Arch. f. Ohrenheilk., vol. xx., p. 2), the percentage of otomycosis among all ear-patients is as follows: Bezold 1 %, Hedinger 0.5 %, Roosa 0.4 %, Burckhardt-Merian 0.3 %, Marian, 0.3 %, Schwartze 0.16 %, Bürkner, Knapp, Gruber, and Shaw-Blake 0.1 %, Lucae 0.09 %, De Rossi, Schalle, and Tröltsch 0.0 %. The average figure is, according to Bürkner, 0.1 %. We shall not lay much stress upon these figures; for those aurists who consider the parasitory invasion as accidental will with less care hunt for hyphomycetes, a fact which will be demonstrated by their statistics.

It would also be desirable to report the cases of private practice separately from those of the dispensary, since the frequency of otomycosis greatly differs in the two. In the "Statistische Uebersicht der Berliner Universitäts-Policlinic für Ohrenkranke" (Arch. f. Ohrenheilk., vol. xiv., p. 126) Lucae states that according to his experience of 10 years the otomycosis is chiefly a disease of well-to-do people, occurring more frequently in private practice. Knapp, who holds a similar opinion (these ARCHIVES, vol. xi. p. 205), had among 866 private patients 11-i. e., 1.4 % cases of otomycosis, and Prof. Moos had verbally made about the same statement. Bezold's figures in his statistical reports from 1881-1883 and from 1884-1886 (Arch. f. Ohrenheilk., vols. xxi. and xxv. 1) agree with these facts, since we find in private practice the proportion of 14:5,707 = 1:121 = 0.82%, and in *dispensary* practice 5:2,565=1:515=0.2 %.

<sup>&</sup>lt;sup>1</sup> We found there, to be true, 54 cases recorded as the entire number of otomycosis patients, whilst we report here only 52 cases. This diminution is due to an exclusion of two cases, after careful revision, because their mould elements could not with certainty be attributed to the hyphomycetes, but they showed a rather yeast-like form.

The frequency among patients treated in private practice is thus four times greater than among the dispensary patients. This remarkable disproportion may depend upon the easy access to medical treatment for dispensary patients, who mostly apply without previous medication, whilst the well-to-do population of cities, and still more that of the country, first make different and improper attempts at curing their troubles themselves, which are followed by otomycosis—i. e., as a secondary affection.

Until the appearance of the mycosis 8 patients = 14 % probably had no trouble; 44 patients = 86 % had had other ear affections before otomycosis. These previous affections were confined to the outer ear in 14 cases = 32 %; to the middle ear also in 14 cases = 32 %; and to the inner ear in 16 cases = 36 %. Among the diseases of the outer ear we emphasize I case of furunculosis, 2 cases of otitis externa, and 9 cases of frequently relapsing inflammation of the external ear—similar to the last-mentioned disease, in which mycosis was then proved.

Among the 14 cases of the middle ear were 9 cases of perforation of the drum-membrane (3 of these with a slight otorrhœa nearing its resolution, the other six dry).

Diseases of the inner ear were 12 cases of hardness of hearing from unknown causes, and 4 cases of nervous hardness of hearing and complete deafness.

The large percentage of patients suffering from affections of the inner ear is noteworthy; among all ear-patients treated by Bezold during the years 1881 to 1886, only 10 % had diseases of the inner ear.

Previous instillation of oil or glycerine, or introduction of fatty materials, was proved in 39 patients = 75 %. Patients suffering from nervous hardness of hearing and deafness, generally those suffering from affections of the inner ear, made by far the most frequent instillations (II of I2 patients = 92 %). Hence it follows that otomycosis is most frequent in diseases of those parts which are farthest from the external ear, and which give therapeutically the least satisfaction, and are therefore most frequently treated by the patients themselves.

It is not quite clear in what manner the oil fosters the development of otomycosis. It is not well suited for nutrition of the mould, but it has the quality of preventing, when used in a small amount—i. e., as a very thin covering layer—in cultures upon solidified serum, the fructifications of air mycelium in favor of a more vigorous thallus growth. Furthermore, we should remember that, according to Raulin's experiments (Annales des sc. nat., ser. v., vol. xi.) aspergillus niger does not develop a strong ferment effect before the exclusion of air, and that further in acute eczemata and in erythemata application of fat frequently increases the inflammation, and at any rate counteracts the drying up of the secretion.

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Symptomatology.—Eight cases = 15 %, two with asperg. fumigatus, two with asperg. flavus, and one with verticillium, were entirely without symptoms. The mould was in these cases located either upon cerumen or a crust. In the cases associated with inflammatory symptoms the most frequently mentioned symptom is: otorrhæa in 30 cases = 58 %, viz., serous discharge in 23 cases; purulent, partly fetid discharge in the 3 verticillium mycoses, cases 20, 24, 46, and 4 other cases—altogether in seven cases. Itching was second in frequency: 25 cases = 49 %. Thirteen patients = 25 % complained of pain; 11 patients = 21 %, of freshly developed or of long-existing impairment of hearing; and 5 patients = 10 %, of subjective noises (humming). Among the objective symptoms I emphasize the following, the seat of the affection was 36 times unilateral, i. e.:

on the right ear in 16 cases = 31 %
" left " 20 " = 38 %

Bilaterally affected were 16 patients = 31 %, in which in each case the same mould was found on either side. In 3 cases the moulds were either upon cerumen or enclosed by it, once (case 28) confined to the tympanic cavity only, and in 2 cases (12, 14) located upon the drum-membrane only. In the remaining cases they were found in the osseous meatus, which in five cases they filled so completely that perfect sac-like casts could be removed (cases 12, 14, 18, 21, 42), the form of which represented the osseous meatus and

drum-membrane in all their details (boundary of drummembrane and wall of the meatus, handle of the malleus, etc.). Two of these cases are illustrated in fig. iv., plate i. In the cartilaginous part and in the auricle mould-masses were never found.

In 40 cases = 38 % the subsequent course was known; it was always favorable. All objective and subjective symptoms disappeared immediately after the introduction of salicyl-alcohol treatment, in most cases after a few days. so that throughout no moulds could be found at the utmost a week after the first examination. Among our 52 cases there is none of an acute development of perforation of the drum-membrane, as in the four cases mentioned by Bezold, in his "Lecture on Otomycosis," and in the case published since by Marian (Report on the Ear-Patients Treated from 1878 to 1880, Archiv f. Ohrenheilk., vol. xvii.). The few cases which took a somewhat abnormal course are as follows: In case 12, a relapse took place after six days; in case 27, itching, and a dirty deposit on the drum-membrane, which was, however, free from moulds, reappeared after three days; in patient 30 (who had been treated before the beginning of the otomycosis for chroniceczema of the external meatus with frequent exacerbations), the discharge and fetor still continued after six days. In patients Nos. 3 and 4, the primary disease (otitis externa and otitis purulenta chronica respectively) also persisted for one and two months respectively after the cure of the otomycosis. Cases Nos. 10, 31, and 33 suffered a considerable prolongation of the course of the disease, on account of the complication with a very painful otitic crouposa, which in one case (31) appeared simultaneously with the otomycosis, and in cases 10 and 33 immediately succeeded it. A similar otomycosis from Bezold's policlinic, complicated with croup of the external ear, was described by Steinhoff ("Observations on Otitis Externa Crouposa," Dissertation, Munich, 1886). Case 53, the history of which has been appended, and also Burckhardt's case, F. S. (history x. from "Die Fadenpilze Aspergillus," etc., 1883), are relevant. As a further complication, furunculosis (in case 10) was

found in the course of otomycosis. A relapse, as was mentioned above, was seen only once. The later, i. e., the reappearance after months or years of the same disease in the same individual, is, of course, not excluded. Three patients = 6 % (case 39 after five years, case 38 after four years, case 13 after 3 years) were thus, as has been proved, affected for the second time with otomycosis.

I regret to say that I could not learn from the history of the cases, whether we had to deal with the same species of mould in the first and second attacks.

The treatment consisted, as has been mentioned in history No. 1, in ear-baths of 2 % salicyl-alcohol, to be applied three times a day for ten minutes, and in daily injections of solutions of boric acid. In case 7 powdered boric acid only, in case o a mixture of boric acid and iodoform āā was prescribed, in both cases successfully.1

The histories of the above-reported 52 patients and their statistical evaluation confirm in general the result of other new contributions to this subject. But in some respects they furnish valuable additions to our knowledge. In conclusion I give a brief résumé of the most important results:

A new case of otomycosis mucorina corymbifer is communicated (the second reported of this kind).

The occurrence of a small penicillium of the peculiar mucor septatus, which has never before been described; and, also, that aspergillus nidulans produces a mycosis in the human ear.

Furthermore, the paper gives an exact description of verticillium graphii, and of its cultivation, and proves its iden-

<sup>&</sup>lt;sup>1</sup> Walb (Boric Acid as an Antiseptic, *Centralbl. f. klin. Med.*, 1882, No. 34) agrees with Dumas, Gahn, Buchholz, Canné, Neumann, and Polli, that 34) agrees with Dumas, Gahn, Buchholz, Canne, Neumann, and Polli, that boric acid in a 1 to 2 % solution does not prevent the development of moulds upon Cohn's nutritive fluid or meat extract. He thinks, therefore, that he is justified in the belief that the otomycosis will resist the application of boric acid. My culture experiments with asperg. niger upon egg-albumen containing boric acid, and also the experience derived from Burckhardt's case 10 (cp. Die Fadenpilze Aspergillus), are in accordance with this fact. If we add larger quantities of boric acid—"exceeding the serum in amount,"—it invariably became, according to my experience (*ibid.*), sterile; neither could I cultivate an aspergillus niger upon gelatine saturated with boric acid. We find indeed in the could be a supergillus niger upon gelatine saturated with boric acid. indeed in literature also favorable reports on the results of treatment with insufflations of boric acid, as, for instance, by Marian (Report on Ear-Patients Treated from 1878 to 1880, Archiv f. Ohrenheilk., vol. xvii.), and by Samuel Theobald (Four Cases of Otomycosis, Amer. Jour. Otol., vol. iii., 2).

tity with the moulds which have been found in the ear before, but have been erroneously identified with "trichothecium," or stemphylium and graphium.

A review of the botanical results reveals an unusual frequency of the occurrence of the single species of moulds in the ear.

Furthermore, a decrease in the frequency of otomycosis during the last years is proven.

We are enabled to confirm the view first proven by Bezold's experience, that instillations of oil into the ear play such an important part in the production of disease as to warrant their special consideration in treatment and prophylaxis.

Occupation as such, residence, and season have apparently no special influence upon the occurrence and development of otomycosis. This affection, however, is more frequent among dwellers in the country than in the city, and more frequent in private practice than among the poorer classes.

With regard to the symptomatology, the material does not offer any new facts. Among the complications otitis crouposa is noteworthy on account of its rare occurrence.

Treatment with 2 % salicyl-alcohol apparently offers sufficient guaranty against relapses.

At the conclusion I express to Prof. Bezold my sincerest thanks, and also to Prof. Bollinger, who generously placed the laboratory of the Pathological Institute of Munich at my disposal.

#### Explanation of the Illustrations.

Fig. 1-Aspergillus nidulans.

- a. Older fruit-head with indistinct structure of the sterigmata.

  Conidia mostly fallen off.
- b. Fruit-receptacle with cup-shaped top.
- c. Younger fruit-head. The fallen off conidia are lying close by as a mass consisting mostly of parallel chains.
- d. Older conidia, partly in chains.

Fig. II.—Verticillium graphii.

- a. Stem-formation.
- b. Normal fruit-bearer, young growth.
- c. Older spores, fallen off.
- d. Older mycelium.

## Botanical and Clinical Contributions to Otomycosis. 273

Fig. III.—Mucor septatus.

- a. Rhizoid formation.
- b. Columella, naked (after bursting of sporangiola).

c. Sporangium.

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- d. Fruit-bearers with burst sporangia.
- e. Torn and compressed columellæ.
- Fig. IV.—Casts of the osseous meatus consisting of mould-masses.
  - a. Solid (with verticillium graphii).
  - b. Hollow, like a cul-de-sac, (with aspergillus fumigatus).

## A RARE CASE OF AUDITORY REFLEXES.

BY H. STEINBRÜGGE, GIESSEN.

Translated by J. B. McMahon, New York.

AM indebted to Prof. Riegel for the opportunity to communicate the following case of hysteria in a male, which, apart from its general clinical interest, may also have some importance in its acoustic and physiological bearings. I am also very much indebted to Dr. A. Hoffmann, assistant to the medical clinic, for his friendly aid in the examination of the patient.

The patient is a countryman, 45 years of age. Fifteen years ago he was suddenly attacked with peculiar convulsive movements, as the result of a severe fright. Since then these attacks have occurred repeatedly under the influence of certain exciting causes. The patient is of medium size, powerfully built, has pale skin and mucous membranes, a poor carriage, and the expression of a sick man. He is afflicted with an umbilical hernia and with inguinal herniæ on both sides. The examination of the chest and abdomen reveals nothing abnormal. The tongue is coated somewhat. Pulse 52. Cardiac sounds weak but pure. The convulsive attacks occur regularly whenever the patient hears instrumental music of any kind. The sound of a child's trumpet was always sufficient to provoke one. Ordinary noises produced, however, no such effect; so with the sound of drums, the tumult of the street, and of railroads. Patient stated that tobacco smoke, and other like influences which tended to cause nausea, as also pressure over the region of the stomach, had occasionally given rise to the attacks, but that it was mainly musical impressions to which they were due.

The course of the attacks was as follows: They began with a

cold sensation which rose from the knees to the stomach, or with a general rigor, then after a few long breaths the respiration became shorter and more rapid, even to the surprising rate of 60 in a quarter minute. Respiration then ceased entirely for a short time, and following this came irregular breathing, occasional vawns, and deep, heavy inspirations. The same chain of phenomena was repeated after a while, with diminished severity and duration; rapid respiration, apnœa, irregular breathing, and this continued till the end of the attack, after some 5 or 10 minutes. The patient meanwhile was conscious, heard well, executed motions as suggested to him, but could not speak. The pupils were normal in size and light reaction. Immediately after the attack patient could only stammer, but he shortly recovered full power of speech. After the attacks he always felt much exhausted, and was very thirsty; he sometimes vomited, and occasionally had severe spasmodic cough and rigors.

It seemed to be essentially a case of respiratory spasm due to reflex irritation of the respiratory centre in the medulla through the auditory nerve. The acoustic irritation seemed also to exert a reflex irritation in the region of the hypoglossal nerve. While it was of special interest that the reflex phenomena were produced mainly through the auditory nerves, it is still more striking that the spasms could be provoked by musical tones only and not by noises. Dr. Hoffmann and I convinced ourselves of this as follows: A tuning-fork (a') placed on the forehead caused an incipient attack, which ceased on rapidly removing the fork; yet the rattling noise of the spring of an induction-apparatus was borne without discomfort, though at the same time a faradic stream was passing through the body of the patient, producing powerful contractions of the muscles of the forearm.

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An examination of the ear gave the following results:

Patient had had an otorrhoea in his youth, but he could not remember in which ear. Hearing for watch R  $\frac{9\cdot15}{10}$  metre; L neither by bone- nor air-conduction. The right drum-membrane showed opaque bands in the anterior half, and a large cicatrix posteriorly, which was partly concealed by a hyperostosis of the posterior and upper part of the external canal. In the left meatus was a hard plug, composed of a mass of epithelium and dried secretions; it could only be removed after softening with a solution

of carbonate of soda. The left auditory canal was also narrowed by a projection of the lower wall; the drum-membrane, visible only in its upper half, was thickened and lustreless. The ears had plainly been the seat of chronic inflammatory processes, probably otorrhea, which had left the conditions described above, and had caused the diminution of the hearing; the possibility could not, however, be excluded, that at some previous time there had been irritation of the end-organs of the auditory nerve, or of the centripetal conduction paths. At the time of this examination, a hyperæsthesia of the auditory nerves was not discovered by the use of the galvanic current; with a current passing obliquely through the head a short noise was heard in the left ear on cathode closure, but not till its strength had been brought up to 8 M. A. Further subjective noises were not complained of.

On removal of the plug which had closed the left ear, the watch was heard on contact; by bone-conduction uncertain. Whisper was heard, right, at 2 metres; left, close to ear. The tuning-fork (a') was heard from forehead equally well in both ears. Rinné's test proved positive on the right side, negative on the left. On using Politzer's method of inflation, the air passed readily into both tympana; on the right side the hearing for the watch was improved to  $\frac{9\cdot2.0}{10}$  metre.

After a single hypnotization and the suggestion of Dr. Hoffmann that the spasms would not recur in the future, the attacks, which had lasted 15 years, did really cease, and up to the present time have not returned. The patient is now entirely insensitive to musical impressions; he can even blow on a harmonica without unpleasant consequences.

Several things are to be taken into consideration if we seek the explanation of the cure of the attacks. In the main we had to deal with a functional or so-called hysterical disease of those portions of the cortex which we are accustomed to regard as the seat of the higher psychical activity, especially of the will. Anatomical lesions proper may be positively excluded, since a single suggestion sufficed to rid the patient of his attacks. In consequence of the weak will-force characteristic of hysterical individuals, the power of inhibition which in the healthy prevents the transference of a nervous impulse from one nerve-path to another, was

<sup>1</sup> At this time the patient was already freed from his attacks.

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diminished, and lastly there existed a chronic diseased condition of the peripheral organs of hearing, which had probably for some time caused a permanent irritative condition of the auditory nerve-paths, and had left a tendency to nervous disturbances of function. We may regard this as analogous to the epileptic attacks which occur after the healing of injuries of the peripheral nerves, and to which the cicatrices seem to bear a causal relation; and also to certain forms of disease (which may have already run their course, or which may still be active) of the female sexual organs, of the nasal and pharyngeal mucous membranes, etc. As a rule, some peripheric disease is necessary for the development of diseased reflex processes, but in addition there must be at the same time a functional weakness of the central organs of the nervous system.

We can easily understand how, in the present case, a definite irritation of the auditory within the medulla oblongata could be conveyed to the region of the pneumogastric and hypoglossal, and so cause the peculiar respiratory spasm and the disturbance of speech.

If we may rely on the description given by Schwalbe, the principal nucleus of the auditory nerve, from which the inner portion of the posterior root takes its origin, borders on the pneumogastric nucleus medially, and this latter again medially on the nucleus of the hypoglossal, so that the anatomical conditions are present to justify the above supposition.2

When we study further the origin of the spasms, one fact seems here to demand special consideration, namely, the difference in the action of musical tones and of noises. The question of the localization of the perception of tones and noises, we know, has not yet been definitely settled by physiologists. Whilst the majority agree in referring to the

<sup>1 &</sup>quot;Lehrbuch der Neurolgie," p. 666.

<sup>2</sup> Freud (Monatsschrift. f. Ohrenheilkunde, 1886, No. 8), with Meynert and Clarke, designates the "principal nucleus" of Schwalbe as the "inner nucleus," and expresses himself (loc. cit., p. 248) as follows: "In the gray matter in the floor of the fourth ventricle, laterally situated, is a somewhat elevated nucleus, which is this along (an oblique conting through the medulla) still sends off filawhich in this plane (an oblique section through the medulla) still sends off filaments to the pneumogastric, but later, without change of position, becomes the 'inner auditory nucleus.'" This goes to prove the close relations between the two nuclei.

cochlea the perception of sounds and tones produced by periodical vibrations, it yet remains an open question whether noises (as Exner, Brücke, and, at present, Helmholtz, now hold) cause a vibration of a considerable portion of the basilar membrane, and a simultaneous excitement of a large number of cochlear nerves; the cochlea, therefore, having the perception of such sounds as part of its functions, or if they produce an impression on the end-epithelium of the nervus vestibuli, the macules of the vestibular saccules coming into play.

In the case under consideration it is certainly worth noting that the hysterical patient did not develop his spasms under the influence of loud noises, as, for example, a shot, but rather under light sounds and tones, which, as we know, are due to periodic vibrations. If we accept the view that these latter set in vibration a number of the fibres of the zona pectinata, and so excite the filaments of the cochlear nerve connected with these fibres, and if we further attribute the perception of noises to the cochlea, the same fibres and the same cochlear nerves are called into play whenever there are contained in the noises any tones which correspond more or less in their vibrations with those of the fibres. It would then, however, be impossible to understand why the irritation of one and the same nerve fibre should at one time produce, without fail, a spasmodic attack; at another, just as surely not. The objection that an attack can only occur as the result of a long series of periodical irritations, and that the vibration caused by noises is, therefore, too short and transitory, is met by the experiment with the induction-apparatus. The periodic and continued action of the spring was well borne by the patient, because it produced no tone, but only noises in rapid succession.

The case seems to be an argument in favor of the view that the sensations of tone and of noises are conducted to the central organ along different nerve-paths; it also increases the probability of the existence of separate perceptive organs in the labyrinth. This would harmonize much better with the observation of otologists, that changes in the hearing-power for speech and for noises do not bear a definite proportion to each other, than would the physio-

logical hypothesis which refers the perception of noiseimpressions to the cochlea.

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The anatomical cause of the fibres of the auditory through the ganglion nuclei of the medulla oblongata to the centre in the cortex of the temporal lobe is difficult to follow and involved as yet in some obscurity. We may here note that in addition to the above mentioned principal nucleus, we have to consider the lateral nucleus, from which one part of the anterior root of the nerve takes its origin, while a second part ascends through the corpus restiforme to the cerebellum; this last seems to be connected with the nerves of the ampullæ. The further relations of the cochlear and vestibular nerves to the roots of the auditory are, to my knowledge, Even the now accepted division (of as yet unknown. Retzius), according to which the ramus sacculi and the branch supplying the lower ampulla belong to the cochlear nerve, does not help to explain the further centripetal course of the fibres. The case under discussion would seem to make it probable that the paths for musical tones lead to the principal nucleus, and that those for noises pass along the anterior root of the nerve.

As for the literature on auditory reflexes in those ill of nerve disease, I know of but one work on the subject, by Prof. Högyes, and that only through a review.¹ The author was able in hystero-epileptics to produce, by lightly sounding a tuning-fork, a movement of the eyes toward the source of the sound, and by keeping up the sound for some time to cause violent reflex muscular spasms. He attributed these phenomena to the transference of the irritation from the auditory paths to the nucleus of the abducens, and to the motor ganglion cells of the spinal cord. These were probably cases of complicated spinal diseases. The case now communicated seems worthy of being placed on record, as it presents a rare pathological experiment, which may some time contribute to the explanation of normal physiological processes.²

<sup>&</sup>lt;sup>1</sup> New Contributions to the Physiology and Pathology of Auditory Reflexes, Orvosi hetilap, 1885, No. 4. Rev. Monatsschr. f. Ohrenheilk., 1885, No. 3, p. 79.

<sup>2</sup> It may be of interest to the readers of the present article, as well as to its author, to learn that Prof. Erb, last winter, presented a patient before the Heidelberg Medical Society, in whom violent respiratory spasms had been caused by both noises and tones—more so by the higher than by the lower ones.—Moos.

# DISEASES OF THE MASTOID PROCESS, WITH A REPORT OF CASES.

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(With four wood-cuts.)

HAT there are many cases of simple inflammation of the mastoid cells, that would recover spontaneously if left to nature alone, I think no surgeon, who has had a large experience in treating this class of cases, will deny. The great difficulty, however, is in deciding whether we are justified in employing simple antiphlogistic measures alone and allowing the disease to run its course, or whether it is not better surgery to open the mastoid cells, even when we are not certain that they contain pus, in order to err on the safe side and prevent the inflammation from extending inwards towards the brain and giving rise to inflammation and abscess or thrombosis and pyæmia, as is frequently the In my experience, the dangers of trephining the mastoid have been very much overestimated, and the more I see of this class of cases, the more inclined I am to operate early. I have never seen any bad results from the operation itself. I would not, however, be understood to treat lightly of the operation of perforating the mastoid, or advise any one without considerable experience in aural practice to undertake this operation. I do, however, believe, that if carefully done and performed under thorough antiseptic precautions, any danger to the patient's life is reduced to a minimum.

In the light of anatomical investigations, we know that no two mastoid processes are exactly alike. According to

Zuckerkandl, who made an examination of one hundred mastoid processes in the fresh state and one hundred and fifty macerated ones, there were absolutely no air cavities in twenty per cent. of the specimens. Of the entire number, thirty-eight and six-tenths per cent. were perfectly pneumatic mastoid processes, without any diploëtic spaces. He also found that in some persons only the upper half of the process was pneumatic, while the lower half was diploëtic. These facts explain, in a way, why in one individual suffering from middle-ear disease, the mastoid cells, where large and pneumatic, may easily be the seat of a severe inflammation from the first. It is probable that in most cases, if not all, of otitis media, the mastoid cells participate in the inflammatory process, and the mastoid process should anatomically be considered a part of the middle ear, as disease of the latter almost always precedes mastoid disease, primary inflammation of the mastoid alone being extremely rare.

In an infant at birth there is usually found but one cell. the antrum and the mastoid process is but a small tuberosity and undeveloped. The antrum in the early months of infancy is covered externally by a very thin wall of bone, which latter is covered by periosteum, and an emissary vein from the mastoid frequently perforates this thin partition of bone. It is easy to understand from these facts why in infants a large swelling frequently appears behind the ear in a very short space of time, even when there may not have been any discharge from the ear at the time, or if present a very slight one. An incision made in these abscesses, so as to allow the escape of pus, is frequently all that is necessary to bring about a cure. At five years of age, the mastoid process of a child is very similar to that of an adult, as regards the position of the antrum and arrangement of the cells, but it is smaller and the bony substance is not as firm and dense as in later life.

Under normal conditions, the mastoid process consists of the antrum, in a position above and behind the tympanum and in direct communication with it, and also of a number of cells, the majority of them probably opening one into the other. These contain air, and are lined with a continuation of the mucous membrane of the tympanic cavity. Those cells which are not pneumatic usually contain a fatty substance. The upper wall of the antrum is but a thin lamina of bone, which separates it from the dura mater. The lateral sinus is in close proximity to the mastoid cells, and rests against the inner wall of this process. The facial nerve may be involved in any case of mastoid disease, as its course is downwards through the cells, after passing through the upper portion of the tympanic cavity. A very important point in the consideration of mastoid disease is the position and course of several blood-vessels and lymph-vessels with their connective-tissue sheaths, which traverse the antrum and tympanic cavity. (The following cases occurred in my practice:)

CASE 1.—Frank T., aged two years, came to the N. Y. Eye and Ear Infirmary February 15, 1887. He had measles a few weeks ago and the right ear has been discharging for a month. An abscess broke behind the ear and this gave relief to the pain.

The right auditory canal is filled with pus. There is considerable swelling of the parts behind the auricle. Fluctuation detected and an incision made with a bistoury, but evacuating very little pus. The probe touches carious bone covering a considerable area, and enters the mastoid antrum. A second point of fluctuation detected above and posterior to the auricle. Very little pus found, but carious bone also discovered here. The sinuses were washed with bichloride-of-mercury solution and dressed with gauze and a bandage applied, rubber drainage-tubes having been previously introduced.

February 18th.—Wounds dressed and looking well. The patient given B. Syr. ferri iod., gtt. xv. three times daily.

March 18th.—The patient etherized and both sinuses laid open by an incision made behind the auricle three inches in length. The bone was found bare and a director passed easily into the antrum, which contained pus. The ear was syringed out with a solution of carbolic acid (1-40) and the stream passed readily through the lower sinus behind the auricle. Considerable broken-down tissue was removed with a curette. The antrum and sinus together with the auditory meatus were then packed with carbolic gauze and a bandage was applied.

22d.—The dressings removed. The ear and sinuses were irrigated with bichloride-of-mercury solution (1-1000). There was considerable discharge on the dressings.

April 8th.—The exuberant granulations about the sinus have been cauterized with nitrate of silver and the ear has been dressed frequently with the bichloride solution, and to-day iodoform has been used. The boy was also given potas. iod., gr. i. three times daily, besides the syr. ferri iodid.

Fanuary 15, 1889.—The boy has been under observation at times ever since. Last summer, a sequestrum of bone came away from the opening behind the auricle, measuring  $\frac{3}{4}'' \times \frac{3}{4}''$ . This had been loose for some time. There is at present no discharge from the meatus. The membrana tympani can be seen through the opening behind the auricle, which is now one quarter of an inch in diameter. The lower and posterior half of the drumhead is destroyed, and the malleus adherent to the inner wall of the tympanum.

There was at one time some discharge from the left ear, but an examination to-day showed that the membrana tympani had healed. The boy seems to hear well.

Case 2.—Ellen D., aged twenty, domestic, came to the infirmary April 5, 1887, and gave the following history: ten days ago she had an earache, right ear, and the pain has been more or less severe since then. She first noticed a discharge April 1st. Today there is less discharge, but the pain was very severe last night. The pain is referred to the auditory canal and right occipital region. No pain or tenderness on pressure referred to the mastoid. She complains of tinnitus of a pulsating and singing character. She has always been a strong and healthy woman.

Watch, right ear,  $\frac{0}{60}$ ". Left ear, normal. The tuning-fork, vibrating and placed on forehead, referred to the right ear. She has naso-pharyngeal catarrh. Right auditory canal contains pusmem. tympani very much congested and angry-looking. Left mem. tympani retracted and hazy; cone of light very small. The artificial leech was applied and blood withdrawn from a point just in front of the tragus. This eased the pain and tinnitus. She was given drops of atropiæ sulph. (grs. ii.-  $\frac{7}{3}$  i.) to be used several times a day.

April 9th.—Somewhat improved, but for two days she has had pain in the left ear. To continue using the same drops.

19th.—Hearing distance, watch, right ear, 10". The pain disap-

pears when the ear discharges. She has had pain at night and some during the day. The mem. tympani is less congested. The ear was inflated gently by Politzer's method, and blood again withdrawn by the artificial leech.

May 21st.—During the past month the patient was seen repeatedly. The pain was better at times, but never absent for long. She was admitted to-day to the infirmary. After ether was given by the house-surgeon, I made a free incision over the mastoid and close to the auricle, down to the bone. No sinus discovered and bone apparently healthy. After dissecting back the periosteum, I perforated the bone with Buck's drill and about half a drachm of pus was evacuated. The cavity was scraped but no communication made with the antrum. The wound was syringed with a solution of bichloride of mercury (1-2000); a plug of gauze inserted in the opening in the bone; iodoform used, and the ear bandaged. The patient had no fever to speak of. She was much relieved by the operation, and had but slight pain at times for a few days afterwards. The ear dressed every day.

Fune 14th.—Mem. tympani healed; dull red. No pain. General health much improved. Hearing distance, watch, right ear,  $\frac{1}{60}$ ". She was discharged from the infirmary to-day and treated outside by my assistant, Dr. Garrison.

24th.—Hearing distance, watch,  $\frac{3}{60}$ . Sinus behind the ear almost closed and very little discharge.

September 1st.—She was seen at times after this. The hearing distance steadily improved; the sinus closed and she was able to resume her work.

CASE 3.—Delia W., æt. thirty-four, married, consulted me May 10, 1887, for pain in the right ear, which she has had since April 10th. For two weeks she has had a swelling over the right mastoid process. Auditory meatus filled with pus and drumhead perforated. The artificial leech was applied over the mastoid.

May 13th.—Pain still present. A Wilde's incision made over the mastoid down to the bone. A poultice to be applied constantly behind the ear.

17th.—She feels much better. She has used the poultice ever since. The swelling has gone down. To continue using the poultice and to syringe the ear.

31st.—The perforation in the mem. tympani closed, but the drumhead still somewhat red, dull, and lustreless. The incision

behind the auricle has healed. Hearing distance, watch, right ear,  $\frac{3}{60}$ ; left ear,  $\frac{10}{60}$ .

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CASE 4.—Jacob R., fourteen years of age, came to the infirmary May 17, 1887. He said that he has had a discharge from the right ear since childhood. He had an earache last week. Day before yesterday considerable swelling appeared in the temporal region, above the auricle and over the mastoid process. There is a cicatrix in this region from a previous operation. Auditory meatus (right) congested and polypus attached to middle ear. No drumhead visible. Swelling behind auricle soft and fluctuation detected. Incision made; some pus escaped. Probe passed easily into the mastoid antrum. Polypus removed with the snare.

Hearing distance: watch, right ear,  $\frac{6}{60}$ "; left ear,  $\frac{6}{60}$ ".

He was directed to syringe the ear with warm water and to apply a poultice over the mastoid process.

May 19th.—The poultice has not been properly applied and the abscess has closed. The swelling behind the auricle much greater. Ether given. An incision three inches long and down to the bone was made behind the auricle and close to its insertion. The pus fairly spurted out, fully an ounce in quantity. A carious opening, \(\frac{1}{4}\)' in diameter, found in the bone, in a position slightly above the upper border of the auditory meatus. The mastoid cells were entirely destroyed, and only a shell remained. The cavity was scraped out and the debris removed. A bichloride sol. (1-2000) was syringed freely through the auditory meatus and out of the mastoid opening. A tent of gauze was inserted in the cavity, and iodoform dusted over and a bandage applied.

31st.—A piece of bone came away a day or two ago. The ear and mastoid cavity have been washed out daily with the bichloride solution, and iodoform has been used in the dressings.

June 24th.—The sinus is gradually closing; the same treatment has been continued.

November 11th.—No discharge from the ear or mastoid cavity. The latter has filled up but little with new tissues. The antrum can be plainly seen through the opening behind the auricle. No trace of a drumhead remains. Hearing distance: watch, right ear,  $\frac{c}{60}$ "; left ear,  $\frac{8}{60}$ ". The tuning-fork not heard through the air nor by bony conduction.

March 17, 1889.—The boy has been seen during the past two winters repeatedly. There has been a slight moisture at times in the mastoid cavity, which has not filled up to any extent. The

wound has been treated mostly by powders, and the patient has been able to attend to work, and he is much improved in health and general appearance.

May 1st.—The mastoid cavity is now entirely free from any discharge; it is kept packed with antiseptic cotton. The hearing distance has improved slightly for the watch, and his ability to hear ordinary conversation is excellent.

CASE 5.—Mrs. C. S. brought her baby, a few months old, to see me, on account of a discharge from both ears, of a month's duration. The baby was teething. There has been a large swelling above and behind the right auricle for some time. An examination showed presence of pus in both auditory canals. There was well-marked fluctuation over the abscess. An incision was made in it at a point just above the upper wall of the auditory meatus and close to the auricle. Considerable pus escaped, and more or less blood. With a probe it was found that the bone was bare. A tent of lint was inserted in the opening, and I ordered that a flax-seed poultice be applied. She was also told to syringe both ears with warm water, and afterwards instil drops of zinc sulph. (grs. ii.— $\frac{7}{3}$  i.) into the ears.

December 17th.—The bare bone was found covered now and the sinus closing. The ears discharge less. The poultices to be discontinued, and the tent was taken out of the sinus, which was allowed to close. The child was ordered cod-liver oil.

CASE 6.—Kate C—, six years old, was brought to see me January 17, 1888. The mother gave the following history: The left ear has been discharging since she was a year old; the right ear also during the past six months. She has always been delicate. An examination showed that there was a large swelling over the left mastoid process, extending from the upper border of the pinna to at least an inch below the lower border of the lobule, and extending backwards two and a half inches. There is wellmarked fluctuation, and pressure over the abscess seems to force out pus from the external meatus. Abscess incised, and a considerable quantity of pus evacuated. No bare bone detected with a probe, and no sinus leading to the mastoid cells detected. She was directed to syringe the ear with warm water, and to use drops of zinc. sulph., and to apply a poultice to the mastoid region. She was also given B. Pil. calcii sulph., aa gr. 10-Sig: one three times daily.

January 20th.—Redressed; no pus; opening closing; drops and poultice to be continued. She did not return.

CASE 7.—Maurice G——, forty-six years of age, a cigar-maker, consulted me March 30, 1888, and said that two years ago he first became deaf very suddenly. He was treated at a dispensary, and cured at the end of two weeks. He had no further trouble with his ears, until two and a half months ago. At that time he noticed he did not hear well with the right ear, which discharged freely. This remained so for about two weeks, when the other ear began to discharge, and the hearing became affected. When the left ear began to discharge the right ear began to heal, and in a week all discharge from it ceased. The left ear continued to trouble him, and, at the same time, the tissues behind and below the auricle became inflamed and boggy. This continued to grow steadily worse. There is severe pain behind the ear, and tenderness on pressure. Discharge slight from the meatus. He has pain also in the frontal and occipital regions.

March 31st—Operation: Ether given by the house-surgeon, Dr. Whiting, and assisted by Drs. Garrison and Adams, I enlarged an incision, which had been made the day preceding, over the mastoid and down to the bone, as the patient was relieved but little, and the temperature remained at 99\frac{3}{5}^\circ F. and pulse was 124. He also complained of being chilly, so that I considered an immediate operation justifiable. I pushed back the periosteum, and with a mallet and chisels made a large opening directly behind the meatus, and found pus and broken-down tissue in the mastoid cells. I did not force a passage into the antrum, as it did not seem necessary. The wound was washed out with a bichloride solution, a rubber drainage-tube inserted, and dressed with iodoform and gauze, and bandaged.

8 P. M.—Temperature 984° F.; pulse, 102. Patient very comfortable, and bore the operation well.

April 1st—Temperature, 99\frac{3}{5}; pulse, 98.

2d.—Temperature—morning, 99; pulse 102. Temperature—evening, 98½; pulse, 96.

8th.—The wound has been dressed daily with bichloride solution and iodoform. The temperature has ranged during the past week between 98\(\frac{1}{2}\cdot -90\(\frac{2}{2}\cdot\); pulse, 88-108.

13th—Temperature and pulse normal during the past week. The patient was given pills of carbonate of iron, strychnia, and sulphate of quinia, three times daily.

21st.—Hearing distance: watch, right ear,  $\frac{2}{60}''$ ; left ear,  $\frac{c}{60}''$ . Sinus behind ear closing nicely. Exuberant granulations, touched daily with nitrate of silver. The canal only exists now, which was

made by the drainage-tube, the rest of the mastoid cavity having filled up with new tissue. Membrana tympani dull, lustreless, and retracted. A very minute perforation seen by Valsalvian inflation in the posterior inferior quadrant. Rubber drainage-tube taken out, and the sinus kept open with a tent of antiseptic gauze.

24th.—Hearing distance: watch, right ear, 2"; left ear, 1". Perforation in drumhead closed; membrana tympani a little The patient has continued to take the iron pills, together with a bitter tonic before meals, and he has had milk punches from the beginning of his illness. He looks much improved to-day.

May 1st.—Sinus healing rapidly; probe enters but a quarter of an inch. Watch: right ear,  $\frac{2}{60}$ "; left ear,  $\frac{1}{60}$ ". Tuning-fork: in the right ear the aërial conduction is better than the bony conduction, while the opposite condition exists on the left side. Left membrana tympani dull and retracted, and almost similar in appearance to the right one. He left the infirmary to-day, but to come in daily to have the ear dressed.

June 30th.—Sinus entirely healed; and he hears the same with both ears.

CASE 8.—John O'K., aged twenty-eight years, came to the N. Y. Eye and Ear Infirmary, May 22, 1888, and gave a previous history of mastoid disease on the right side, and showed the cicatrix over the mastoid process, made at an operation eight or nine years ago. Eight months ago the left ear pained him, and he thought that something burst in the ear, and since November there has been a discharge. Since Christmas there has been a swelling behind the ear, and a discharge from a sinus, an incision having been made in this region by a doctor at the time.

The patient is run down, but gives no history of syphilitic disease. No appetite. He has some fever, and cannot sleep.

Admitted to the infirmary to-day.

Hearing distance—watch: right ear,  $\frac{1}{60}$ "; left ear,  $\frac{6}{60}$ ". Tuning-fork: Bony conduction better than the aërial for both ears. The tuning-fork, when placed on the vertex, heard louder in the left ear.

Right mem. tympani dull and hazy in appearance, and retracted. Left meatus contains pus. There is a large swelling behind the left ear, extending down the neck. Fluctuation well marked. A sinus leads directly inwards to the mastoid cells, which are carious.

May 22d.—Operation: An incision was made behind and close to the auricle, about two inches in length, down to the bone. Quite a large carious opening was found in the bone and leading to the mastoid cells. Carious opening enlarged, and carious cells and granulations and broken-down tissue and cheesy matter removed with a curette. Drainage-tube inserted, and mastoid cavity washed with bichloride solution and dressed with iodoform and gauze, and a bandage applied.

The patient came out of the ether, having stood the operation well

23d., A.M.—Pulse, 108; temp.,  $99\frac{2}{5}^{\circ}$ . P.M.—Pulse, 106; temp.,  $98\frac{1}{2}^{\circ}$ . Wound dressed as before.

29th.—Ear and mastoid cavity dressed daily. No elevation of temperature at any time. The cavity filling up with new tissue Very little discharge.

June 1st.—Patient allowed to leave the infirmary, but to come in daily to have the ear attended to.

21st.—He has been in almost every day since. The sinus behind the ear has closed now, and the drumhead is healed. Hearing much improved, and he was discharged cured.

Case 9.—A. A., twenty-one years of age, Norwegian, consulted me May 11, 1888, and said that he has had a discharge from the right ear at times, since he was a child. He has occasionally had more or less pain in the ear. Three years ago the right ear commenced to discharge, and this continued for about a year. It seemed to be cured, and caused him no further inconvenience until six months ago. Since then there has been a constant discharge. His general condition has been fairly good, but he is anæmic. At present there is a profuse discharge from the ear, and on examination with a probe I discovered a very small sinus in the posterior wall of the bony auditory canal, leading backwards and inwards into the mastoid cells. Carious bone felt with the probe, and cheesy matter comes out of this sinus. No swelling nor pain about the mastoid process. Left mem. tympani very much retracted, but fairly normal as to color.

Operation: Ether given. I made an incision about two and a half inches long just behind the auricle, down to the bone, and pushed aside the periosteum. An opening about half an inch in diameter was made with chisels and mallet in the bone, just behind the auditory meatus. The mastoid cells were found entirely destroyed, and the cavity filled with a very thick, cheesy, fœtid matter, cholesteatomatous in appearance, and so thick that it could not be syringed out. The entire contents were removed

with a curette and by syringing, the water passing freely through the antrum and external meatus. After thorough irrigation of the wound with bichloride solution, the cavity was packed with iodoform gauze and a bandage applied.

Temperature, 99 6 F.; pulse, 64. He complains of little pain,

and stood the operation well.

May 25th.—The mastoid cavity has been dressed daily with bichloride solution and iodoform, and to-day a drainage-tube was inserted instead of packing the cavity with antiseptic gauze. Hearing distance, watch, right ear,  $\frac{0}{60}$ "; left ear,  $\frac{12}{60}$ ". The watch is heard with the right ear, when placed on the right temple. When the tuning-fork is placed on the vertex or teeth, it is heard slightly better with the left ear. The bony conduction is better for both ears than the aërial conduction.

30th.—Pulse, 72; temp.,  $99\frac{3}{4}$ . The same treatment continued and the cavity has been slowly filling up.

June 9th.—Patient allowed to leave the infirmary, but to come in to have his ear dressed. Since May 30th there has been no rise in temperature.

21st.—Exuberant granulations cauterized with nitrate of silver. Discharge not very healthy and of a disagreeable odor. Dressed in the same way.

23d.—There has been no pain at all about the ear. Sinus nearly healed. Watch, right ear,  $\frac{3}{40}$ .

30th.—Sinus all but healed. No discharge from it nor from the ear. Right mem. tympani adherent more or less to inner wall of tympanum and composed mostly of cicatricial tissue.

CASE 10.—Henry de G—, twenty-two years of age, consulted me October 17, 1888, and said that he had always been healthy and never had any ear trouble before last July, when he had an earache on the left side, from a cold in the head, as a result of sea-bathing. The ear commenced to discharge about August 1st. He has had severe pain all the time, but especially at night. He has been deaf in the right ear since a child, as a result of a fall.

On July 11th, my assistant, Dr. Garrison, made a Wilde's incision over the mastoid (left) down to the bone, which he found bare and evacuated some pus. The pain was relieved as long as the wound was kept open. I saw him for the first time on October 9th. The sinus had again closed and the pain had recommenced. I opened the sinus and allowed some pent-up matter

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to escape, and with a probe, detected carious bone and passed it into the mastoid cells. A rubber drainage-tube was inserted and the sinus washed out with a bichloride solution and dressed with iodoform and bandaged. Left mem. tympani sodden and somewhat congested above. No perforation seen nor heard when the patient inflated the ear by the Valsalvian method. Right mem. tympani dull, retracted, and lustreless. Hearing distance: watch, right ear,  $\frac{0}{60}$ , heard only when placed on the mastoid process or right temple; left ear,  $\frac{12}{60}$ . Tuning-fork heard only on the right side, when placed on the mastoid process. On the left side the aërial conduction is better than the bony.

October 17th—Operation: Ether given. I made an incision two inches long, just behind the auricle and close to it, down to the bone and pushed back the periosteum. I found a carious opening in the bone, about the middle of the process, leading into the mastoid cells. This I enlarged slightly, with chisels and mallet. Very little if any pus found in the mastoid, which was found filled with softened bone and granulation tissue, all of which I removed with a sharp spoon, leaving a considerable cavity. This was washed with a bichloride solution (1-2000) and dressed with iodoform and bichloride gauze, a silver drainage-tube having first been inserted into the cavity and held in position by a suture through the integument and fastened to a small opening in the tube. The edges of the incision were brought together by suture above and below the tube, a piece of gauze soaked in bichloride was laid over the wound and a bandage applied.

November 23d.—The patient had little, if any, rise in temperature after the operation, which he bore very well. There was primary union of the edges of the wound, which were brought together by suture. The same treatment was carried out with the bichloride solution and iodoform. Watch, left ear,  $\frac{80}{60}$ . Left auditory canal somewhat narrowed and congested still, with the dermal layer peeling off. Mem. tympani dull, and opaque, and congested along the handle of the malleus. A few days after the operation, the silver tube was removed and a smaller one introduced, ar to-day this one was taken out. The mastoid cavity has filled up with new tissue with the exception of the canal kept open by the tube. A tent of antiseptic gauze was inserted to-day in the sinus and the wound dressed as before.

30th.—The integument had closed over the sinus to-day, so that Dr. Adams, the house-surgeon, found it necessary to open it again and pack it with iodoform and gauze.

December 15th.—Since November 30th, the sinus has been kept open by packing it with gauze soaked in bals. of Peru, as a dressing. There is still a carious point detected with the probe.

February 15th.—It has been difficult to keep the sinus open externally. Still a carious point in the mastoid cavity. The sinus was dressed as before, with Peruvian balsam until February 1st, when I substituted alcohol and iodoform, which I dropped daily into the wound with marked benefit. I gave him at times tablets of chloride of gold and sodium, aa. gr.  $\frac{1}{30}$ , three times daily, as well as Fellows' comp. syr. of the hypophosphites and a tonic of iron and quinine.

April 22d.—The sinus closed April 10th. There is no pain in the ear nor mastoid. No tenderness over the mastoid on pressure.

CASE 11.—Edward V., native of Germany, forty-two years of age, a driver, was admitted to the infirmary April 2, 1889.

He has always enjoyed good health. No history of syphilis or tuberculosis. He has never had trouble with his ears previous to the present attack. He caught a severe cold six weeks ago, and in the course of a few days the right ear became painful, with the hearing impaired, and a few days later there was a discharge from the ear. The pain and discharge ceased at the end of two weeks, but leaving the patient deaf in the right ear. At this time (four weeks ago), the left ear became painful and the hearing impaired, followed in the course of a few days by a discharge of pus from the canal. The pain continued for about two weeks. Two weeks ago, the right ear became again affected, the pain being more severe and not confined to the ear alone, but extending over the side of the head. There was a discharge from the ear until six days ago.

Four days previous to his being admitted to the infirmary, as he complained of pain and tenderness on pressure over the mastoid, leeches were employed in that region.

When admitted the patient was pale and thin, with an anxious expression, and suffering severe pain in the right ear and side of the head. No discharge from the ear. Mastoid region swollen and very tender on pressure. Very deaf in both ears. Pulse 80 and feeble. Temperature not taken. He has not had any disinct chill.

Operation.—Patient etherized and an incision, two inches long, made from the upper border of the auricle downwards and close

to it, in the mastoid process. No pus found, but the bone was bare and rough, and the periosteum separated. With chisel and mallet I made an opening into the cells, at a point just above and behind the external meatus. I entered the antrum but found no pus until I pushed a director downwards into the apex, when about two drachms were evacuated. Soft granulation tissue and some carious bone were removed with the sharp spoon. The wound was washed with the bichloride solution and dressed with iodoform and gauze. A rubber drainage-tube was introduced into the wound, and the upper edge of the wound brought together with silk sutures. The wound covered with antiseptic gauze and bandaged.

The patient bore the operation well. 8 P.M.: temp., 103\frac{4}{5}^{\circ} F.; pulse 78.

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April 3d.—8 A.M.: temp., 99\frac{3}{6}^6 F.; pulse, 56.
4 P.M.: temp., 102\frac{2}{5}^6 F.; pulse, 66.
6.30 P.M.: temp., 103\frac{6}{5} F.; pulse, 68.
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The temperature did not rise any higher during the day than 103° F.

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April 4th.—8 A.M.: temp., 99\frac{2}{5}^{\circ} F.; pulse, 67.

I P.M.: temp., 104\frac{3}{5}^{\circ} F.; pulse, 72.

6 P.M.: temp., 104\frac{4}{5}^{\circ} F.; pulse, 80.

II P.M.: temp., 102\frac{4}{5}^{\circ} F.; pulse 68.
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The patient was given antipyrine at first and afterwards quinine in moderate doses, besides milk punches and beef tea. Dr. Robert F. Weir saw him with me in consultation, and it was decided best to discontinue the antipyrine and quinine and to watch the variations in temperature, as it was suspected that there might be a cerebral abscess, although he complained of no pain. He complained of being chilly at times, but had no regular chill. He perspired but little. The eyes were examined but nothing abnormal found about the fundus.

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5th.—8 A.M.; temp., 98\frac{4}{5}^{\circ} F.; pulse, 62.

11 A.M.; temp., 97\frac{4}{5}^{\circ} F.; pulse, 45; resp., 18.

2 P.M.; temp., 101^{\circ} F.; pulse, 70; resp., 20.

7 P.M.; temp., 104\frac{4}{5}^{\circ} F.; pulse, 72; resp., 24.

6th.—8 A.M.; temp., 101\frac{4}{5}^{\circ} F.; pulse, 72; resp., 24.

3 P.M.; temp., 103\frac{4}{5}^{\circ} F.; pulse, 75; resp., 24.

9 P.M.; temp., 103\frac{2}{5}^{\circ} F.; pulse, 79; resp., 28.
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The pulse has gradually become more rapid and feeble. He was given quinine in 5-gr. doses several times a day, besides whiskey and milk and beef tea.

7th.—8 A.M.; temp.,  $101\frac{3}{4}^{\circ}$  F.; pulse, 92; resp., 24. 2 P.M.; temp.,  $103\frac{4}{5}^{\circ}$  F.; pulse, 100; resp., 36.

The wound looks fairly well, and has been dressed daily with the bichloride solution and iodoform.

11 P.M.; temp., 102\frac{3}{5}\circ F.; pulse, 82; resp., 25.

8th.—8 A.M.; temp.,  $102\frac{1}{5}^{\circ}$  F.; pulse, 64; resp., 24.

2 P.M.; temp., 103\frac{4}{5}\circ F.; pulse, 61; resp., 24.

11 P.M.; temp., 1021° F.; pulse, 95; resp., 36.

10th.—8 A.M.; temp., 1014° F.; pulse, 100.

2 P.M.; temp., 103\frac{4}{5}\circ F.; pulse, 101.

7 P.M.; temp., 1014° F.; pulse, 102.

11th.—8 A.M.; temp., 1014° F.; pulse, 80.

2:30 P.M.; temp., 102\frac{2}{5}\circ F.; pulse, 100.

11 P.M.; temp., 100\frac{1}{5}\circ F.; pulse, 86.

12th.—The highest point reached to-day by the thermometer was 101\frac{3}{4}\circ F., at 2 P.M.

13th.—8 A.M.; temp., 1015° F.; pulse, 88.

3 P.M.; temp., 102 10 F.; pulse, 100.

9 P.M.; temp., 1021 F.; pulse, 94.

The same treatment has been carried out daily, viz., whiskey and milk and quinine, and the wound has been washed as before. Discharge very slight.

14th.—8 A.M.; temp., 1003° F.; pulse, 94.

2 P.M.; temp., 1025° F.; pulse, 68.

15th.—8 A.M.; temp., 100\( \frac{4}{5}\) F.; pulse, 64.

11 A.M.; temp., 1013° F.; pulse, 92.

An examination of the chest to-day showed the presence of some pleuritic friction sounds and diffused râles over both lungs. He was given digitalis in small doses.

16th.—8 A.M.; temp., 100° F.; pulse, 84.

3 P.M.; temp., 1011 F.; pulse, 95.

7 P.M.; temp., 100\frac{1}{5}\circ F.; pulse, 76.

17th.—8 A.M.; temp., 100\frac{2}{5} F.; pulse, 78.

2 P.M.; temp., 101 1 F.; pulse, 98.

7 P.M.; temp., 102° F.; pulse, 88. 18th.—8 A.M.; temp., 100½° F.; pulse, 78.

3 P.M.; temp., 102\(\frac{1}{6}\) F.; pulse, 82.

11:30 P.M.; temp., 995° F.; pulse, 81.

19th.—8 A.M.; temp., 1001° F.; pulse, 90; resp., 24.

1:30 P.M.; temp., 1015 F.; pulse, 100; resp., 26.

20th.-8 A.M.; temp., 98° F.; pulse, 76.

8 P.M.; temp., 1012° F.; pulse, 78; resp., 27.

21st.—8 A.M.; temp., 97° F.; pulse, 80; resp., 24.

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9 P.M.; temp., 1012 F.; pulse, 95; resp., 24.

22d.—Temperature normal all the morning, but it rose to 1013° F. at 7 P.M.

23d.—The temperature did not rise above 99% F. to-day.

28th.—The temperature has steadily become lower, and the patient has been gradually improving. The chest has been clearing up, and the cough becoming less. The patient's appearance has changed very much, and he no longer has an anxious expression. Peruvian balsam has been used instead of the iodoform in the wound, and a tent of gauze has been used instead of the rubber tube. The mastoid cavity is gradually filling up with new tissue. The patient begins to eat well now, and has been allowed some solid food.

May 10th.—Opening into the mastoid at present is very small. Only one or two bare points felt with the probe. Almost the entire cavity filled with new dense tissue. Left mem. tympani dull, lustreless, and thickened. Right external meatus contains some cerumen and powder, which was removed. Mem. tympani dull, red, and thickened. Tuning-fork on vertex heard louder with the left ear. The aërial conduction better on both sides than the bony. Watch right ear,  $\frac{1}{60}$ ; left ear,  $\frac{1}{60}$ . The sinus is kept open with a small tent of iodoform gauze and a piece of rubber plaster over it. Patient allowed to sit up each day for a short time.

24th.—The patient has been gaining steadily in every way. Sinus behind ear entirely closed now.

Watch: right ear,  $\frac{10}{60}$ ; left ear,  $\frac{0}{60}$ ". He hears ordinary conversation now quite well. Right mem. tympani dull, lustreless, opaque; no cone of light. Left mem. tympani dull and reddish, and canal slightly congested. This ear has annoyed him slightly for a few days past with slight pain and tinnitus. The ears were inflated after Politzer's method, and he was given drops of zinc. sulp., grs. iv.— $\frac{\pi}{3}$  i., to instil in the left ear.

June 1st.—He has been cared for as an out-patient for some days past, and is steadily improving.

Case 12.—Katie S—, native of the United States, 7 years of age, came to my clinic at the infirmary, April 23, 1889. Her mother said that she has never had any ear disease before the present trouble, and has always been a strong, healthy child,

until about fourteen months ago, when she had scarlet-fever, followed by diphtheria. The right ear pained her at the time and there has been a discharge from it ever since. She has had several abscesses in the neck opened. There is at present a very offensive discharge from the ear and also from a sinus behind the auricle, leading to the mastoid antrum. A probe reveals carious bone.

April 24th. Operation: Ether given by Dr. Adams, housesurgeon, and assisted by Dr. Gibson, I made an incision two inches long, down to the bone, laying open the sinus, and found a large carious opening into the mastoid, about half an inch in diameter. Most of the posterior bony auditory wall was destroyed and the carious process involved the tympanic cavity. large sequestra of bone were removed. The drumhead and ossicles were entirely destroyed. All the carious bone, granular tissue and débris were removed with a sharp spoon and chisels, nothing remaining of the mastoid but a mere shell. A rubber drainage-tube was introduced from behind and brought out through the external meatus, also a larger tube into the mastoid cavity. After thorough irrigation of the wound with the bichloride solution, iodoform and antiseptic-gauze dressing was applied and the ear bandaged.

26th.—Ear dressed to-day and the wound looks very well. No rise in temperature and no pain since the operation.

1st.—The child out of bed and around the ward and feeling very well. The ear has been dressed about every other day.

14th.—Opening in the bone gradually getting smaller. She hears ordinary voice close to the ear. Mastoid cavity filling up. The drainage-tube, running through from the posterior opening and out of the ext. auditory canal, was removed a few days ago, and the other one was taken out to-day. Only one bare point of bone was discovered. Discharge slight. Dressed as before except that a tent of gauze was substituted for the rubber tube. Tuning-fork when placed on vertex and vibrating, heard better with the right ear.

24th.—Sinus behind right ear closed and mastoid filled up with new tissue. Very little discharge from the ear. Some powder of zinc ox. et acid. borac. insufflated. Left ear has been discharging for the past few days. Ordered to syringe the ear and use drops of zinc. sulph. (grs. iv.- \( \frac{7}{3} \) i.). She was also given syr. ferri iod., gtt. xv., three times daily.

June 4th.—There has been some discharge from the right ear, probably caused by a sequestrum (very small) of bone, removed to-day with forceps. Zinc. oxid. et acid. borac. powder was insufflated. To continue same drops in the left ear.

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CASE 13.—John D-, æt. twenty-five, a clerk, consulted me in the latter part of April, 1885. He said he has never had ear trouble before. He frequently has a "cold in his head." His appearance does not denote very robust health. He is a dyspeptic, and has to be careful about his diet. Ten years ago he had typhoid fever and pleurisy at the same time. He has also had scarlet-fever, measles, and diphtheria twice, but some years ago. The present ear disease commenced the middle of February and was caused by his sniffing up some glycerine to relieve a bad "head cold." On the following day, he awoke with a dull feeling below the right mastoid. The ear discharged the next day, and he had pain for several days. The discharge at first contained mostly mucus, but afterwards pus. He consulted two physicians, and was treated by them for two months, the treatment consisting in douching the ear with warm water and the application of nitrate of silver. He derived no benefit, however, the pain and discharge continuing.

When he came to me, an examination showed that he had hypertrophic nasal catarrh, with the septum deviating to the right side, so that the passage was very much contracted.

Left mem. tympani, dull, lustreless in appearance; somewhat sodden, and it does not move when the air is exhausted by Siegle's otoscope. No cone of light. The right mem. tympani considerably destroyed and the external meatus narrowed. The posterior bony auditory wall congested and sensitive when touched with a probe. A hard polypoid mass above and coming apparently from the antrum.

Hearing distance: acoumeter, right ear,  $\frac{1}{2}$ "; left ear, 4". He hears only loud voice. Tuning-fork vibrating and placed on the vertex cranii, heard a little louder in the right ear. The bony conduction is better than the aërial for both ears. The discharge from the right ear, darkish brown and offensive. The polypoid mass was cauterized several times and the ear treated with different powders (dry method) with some improvement, as the discharge became less and the hearing distance for both ears was increased by means of Politzer inflation. The improvement was but temporary, however, as the auditory canal (right) became

narrower and more painful in the posterior bony portion. He had pains, at times referred to the right mastoid, and there was a very tender spot on pressure just behind the auricle and near the antrum.

The symptoms all pointed to carious bone in the mastoid, so that I decided at once to perforate the mastoid process.

Fune 2d.—Ether given by the house-surgeon, Dr. Lewis, I perforated the bone with Buck's drills, just behind the ext. meatus and found pus and granular debris, which I scraped away, and passed a director well up into the antrum.

The wound was washed with a bichloride solution, and dressed with iodoform, and a tent inserted to keep the wound open. The patient was kept in bed for a few days, suffering but slight discomfort, and with little if any elevation of temperature.

6th.—Patient improving. Discharge from the canal less, and mastoid dressed in the same way.

Hearing distance, acoumeter, right ear, 10"; left ear, 4". Tuning-fork on vertex, heard a little better with the right ear. The lower notes of a Galton whistle heard quite plainly across a room, a distance of 15 feet, but the high notes heard only at the distance of a few inches.

7th.—He says he hears very much better since yesterday afternoon, when the discharge first came from the opening in the mastoid. No discharge now from the ext. meatus. No pain. Same treatment continued. Eustachian catheter used in the left ear.

23d.—Hearing disturbance for the voice much improved.

July 7th.—The patient was allowed to leave the infirmary soon after the operation, and treated as an out-patient. He has had some cold in his head, and the discharge from the ear is increased in quantity. The canal is well dilated now, the perforation is closing gradually, and the polypus has disappeared. Sinus behind the ear gradually closing also. He was given pil. ferri et quiniæ cit., aa gr. ij., three times daily. The ear was treated by the insufflation of powders.

October 22d.—The discharge from the ear ceased about August 20th, and there was gradual improvement in the patient's condition, and the sinus closed some time before the ear stopped running. Acoumeter: right ear,  $5\frac{1}{2}$ "; left ear, 2". After the use of the catheter: right ear, 13"; left ear, 2". He hears ordinary conversation much better than ever before. No perforation in the

drumhead, which is somewhat congested about Shrapnell's membrane and opaque below. There is some tinnitus, which has been present ever since the commencement of the attack, but otherwise he is well.

Case 14.—Ferdinand V—, seven years of age, was seen by me February 26, 1889. His father said that a year ago he had a noise in the left ear, and some wax was removed. Three weeks ago he had measles, and for the past two weeks the left ear has pained him. Ten days ago a swelling appeared behind the left ear, when the pain in ear became less. The pain has been worse at night, and he has had some fever.

An examination showed that there was some cerumen in the left meatus. On removing this the dermal layer of drumhead and ext. meatus was found peeling off. No perforation in the mem. tympani, which is dull red. A large abscess exists behind the auricle, with well-marked fluctuation, extending from the ext. meatus upwards to one half an inch above the upper border of the auricle and backwards for nearly two inches from the attachment of the auricle.

He has enlarged tonsils and chronic naso-pharyngeal catarrh.

An incision was made in the abscess, and half an ounce of pus and blood evacuated. A probe introduced, touched carious bone and entered the antrum. Abscess cavity washed well out with a carbolic-acid solution, but no liquid could be forced through the mem. tympani from the posterior opening. A tent of antiseptic gauze inserted to keep wound open, and iodoform dusted over and a bandage applied. He was given syr. ferri iod., gtt. x., to be taken three times daily.

March 15th.—The sinus has been washed out every two or three days with carbolic solution and drops of alcohol and iodoform instilled. The bone is still bare, but is gradually being covered over. Some granulations have been touched with nitrate of silver. The bandage was left off yesterday and rubber plaster used instead. The auditory canal contained some epidermal scales, which were removed and some boracic-acid powder insufflated.

19th.—Mem. tympani clearing up, and but slightly congested now. To continue the iron. Sinus closing slowly.

29th.—Drumhead looks fairly normal now. Hearing distance, watch, 3". Right canal contains some cerumen, which was removed. Sinus behind ear entirely healed. No pain nor tenderness on pressure. Ears inflated by Politzer's method.

CASE 15.—Daniel McA—, aged thirteen years, came to the infirmary April 19, 1889, and said that last night he had sudden pain in the right mastoid process, and the swelling appeared behind the ear, which stands out prominently. Pain severe all night. He has been attending here for the past six weeks, as the right ear has been discharging, and he has been using the warmwater douche and drops of sulphate of zinc (grs. iv.- \( \frac{7}{3} \) i.), and the discharge has been growing less.

The house-surgeon, Dr. Adams, under my directions, made a Wilde's incision down to the bone. The periosteum was found loosened and the bone bare over an area of about a quarter of an inch.

The wound was washed with a bichloride solution  $(\frac{1}{2000})$  and dressed with iodoform and a tent inserted to keep it open. A bandage was applied, and he was allowed to go home after the effects of the ether had passed off.

April 21st.—Ear dressed to-day as before. No pain since.

26th.—The ear has been dressed twice since in the same way. There has been some muco-purulent discharge from the ear to-day, although since the Wilde's incision it has been quite dry. Ear syringed with warm water and he was directed to use zinc drops at home, several times a day. Mem. tympani has a large perforation. Wound behind the auricle healthy and granulating from the bottom, although the bone is still bare. Hearing distance, watch, right ear  $\frac{2^{16}}{60}$ . Left meatus filled with cerumen: removed by syringing.

May 3d.—Less discharge from the ear. Bone gradually being covered. Same treatment continued.

7th.—The pain commenced again, and as the bone was still bare and the ear discharging, and the meatus contained granulations so that it was difficult to see the drumhead, I again gave him ether and made an incision down to the bone, commencing at the upper border of the pinna and carrying it downwards for two inches, close to the attachment of the auricle, joining at an acute angle with the previous incision. The bone was found very soft and the mastoid was easily perforated with chisels and mallet and soft bone and granulations were removed. The size of the opening in the bone was about a quarter of an inch and on a level with the upper border of the external meatus.

No communication through the antrum could be easily established, as the bone was hard. The mastoid cavity and ear were

thoroughly washed with bichloride solution and dressed with iodoform, and a gauze tent inserted in the wound and a bandage applied. The patient was kept in bed and bore the operation well.

25th.—There has been no rise in temperature to speak of, and the wound, which has been dressed in the same way, has been healing nicely. No discharge from the ear. Sinus still open, but the opening in the mastoid has closed. The bandage was left off to-day, a tent of gauze being inserted and kept in position by rubber plaster over it.

28th.—Right mem. tympani still perforated, but no discharge from the ear. Very little congestion. Powder of zinc. oxid. et acid. boracic, insufflated.

Left mem. tympani somewhat retracted, thickened especially in the posterior half. Cone of light small. Hearing distance: watch, right ear,  $\frac{4}{60}$ "—left ear,  $\frac{36}{60}$ ". The tuning-fork, when vibrating and placed on the vertex, heard better with the right ear. The aërial conduction better than the bony conduction for both ears.

Fune 4th.—Sinus all but closed. Perforation still seen in the drumhead, but there has been no discharge. The patient allowed to leave the infirmary.

CASE 16.—Andrew B—, aged 30, a Swede, came to the infirmary October 24, 1888. He said that he has never had any trouble with his ears before the present attack. About a year ago, he had a bad cold, followed by pain and discharge in the left ear. He had also more or less pain behind the ear. There has been more or less discharge from the ear since last November. Last August, he again had pain in the mastoid, and a doctor made an incision there in September. He was told to syringe the ear with warm water and instil some drops, and to apply a poultice over the mastoid.

Examination.—Hearing distance for the watch, left ear,  $\frac{60}{60}$ . Tuning-fork, when placed on the mastoid, heard louder in the left ear. A sinus exists behind the auricle, the external opening being about two inches from the insertion of the pinna and on a level with the lower border of the lobule. A probe introduced passed readily into the mastoid cells.

October 24th.—Operation: The patient was etherized by the house-surgeon. I then made an incision, two inches and a half long, just behind the auricle, in the mastoid, down to the bone. A

carious opening found; this was enlarged with chisels and a sharp spoon and about half a drachm of pus and granular tissue were removed. The cavity was thoroughly washed out, in the usual way, with a bichloride solution. A silver drainage-tube was inserted and the wound was dressed with iodoform and gauze. The edges above and below the tube were brought together by silk sutures, and considerable granulation tissue was scraped away in the track of the original sinus. The patient came out of the ether well and passed a good night.

25th.—Temperature, 8 A.M., normal. 7 P.M., 101° F. 26th.—8 A.M., temperature 98½° F. 8 P.M., 100° F.

Wound dressed and found healthy-looking. A small pocket, just behind and below the apex of the mastoid, was laid open and scraped the day of the operation. A probe shows that the collection of matter in the mastoid had made a sinus through the tip of the process and burrowed beneath the deep tissues, in a direction backwards, downwards, and inwards.

November 1st.—The wound has been washed in the same way. The mastoid has filled up somewhat with new tissue, but the pocket below is slow in healing. The patient has had no elevation of temperature to speak of.

December 17th.—An operation was decided upon to-day, as the sinus has not healed at all, although a solution of nitrate of silver has been injected repeatedly to stimulate it, as well as bals. of Peru, but there has been a tendency for the pus to collect at the lowest point, and there is some induration of the tissues. Ether given by Dr. Gibson and assisted by the house-surgeon, Dr. Adams, I introduced a probe, which passed downwards, backwards, and inwards for a distance of at least four inches, towards the third cervical vertebra. No carious vertebra discovered. An incision was made through the tissues externally at the lowest point, so that the probe came through. A director was then substituted for the probe and the entire sinus laid open, so as to allow it to granulate up from the bottom (see fig. No. 1). There was also found to exist a second pocket, starting from the upper opening of the first sinus and leading forwards towards the angle of The free incision seemed, however, sufficient to drain this. The bichloride solution (1-1000) was used, and a rubber drainage-tube inserted and passed inwards and forwards towards the angle of the jaw. It was then packed with iodoform gauze. The mastoid was found to contain soft granulations, and on removing these some bone was felt with the probe. A very small silver tube was reintroduced in the mastoid. The whole was then dressed with iodoform and gauze applied.

19th.—Wound dressed to-day. Very little discharge and every thing looks well. Patient out of bed this afternoon. No elevation of temperature.

February 1st.—The mastoid and sinuses have been dressed daily with the bichloride solution and iodoform. Bals. of Peru has also been used at different times. There has been considerable difficulty in getting the cavity to heal up from the bottom. The lowest part has filled up, but a sinus has remained, running in a direction forwards and slightly downwards and outwards. A



Fig. I.

small opening still remains in the mastoid. This latter, as well as the other sinus, has been stimulated with comp. tr. benzoin. and iodoform in alcohol.

roth.—Patient left the infirmary to-day, but he is to come in to have the wound dressed every day. He was given a tonic of iron and quinine, and is improving steadily in appearance and general health.

15th.—To-day I began using as a stimulating injection, R. Zinc. sulph., cupri. sulph., each fifteen parts; liq. plumbi subacet. thirty parts, and vinegar 300 parts, diluting it one half with water. Both sinuses began to close and improve at once.

April 1st.—The sinus below the mastoid has closed, and the one in the mastoid is steadily growing smaller.

May 4th.—Sinus in mastoid closed (see fig. No. 2). Hearing distance: watch, right ear,  $\frac{34}{60}$ "; left ear,  $\frac{P}{60}$ . Watch is heard also, when placed on the left mastoid and temple. Some scales and a little thick pus in the lower part of the left auditory meatus were removed to-day and boracic acid insufflated. There is a small perforation in the lower anterior quadrant. Right mem. tympani fairly healthy in appearance, but showing evidences of catarrhal changes. The patient has also chronic atrophic rhinitis.

18th.—For several days he has felt very badly, suffering from headache, general malaise, loss of appetite. He has some fever, and an examination of the chest showed that there was bronchial breathing at the apex and upper lobe of the left lung, and well-



FIG. 2.

marked symptoms of phthisis. He was sent to the N. Y. Hospital for treatment.

Fully 25th.—The patient has been improving under treatment and a report from the hospital to-day says that "the patient has cavities in each lung; a condition of pneumothorax in the right lung posteriorly; some dyspnœa; pleuritic adhesions; lung bound down at the base. He goes out of the hospital every day for an hour or so, and were it not for his dyspnœa one would think him a very strong and robust fellow."

If we are fortunate enough to see an acute case of mastoid disease, whether inflammation of the periosteum or of the cells, we can frequently cut short the disease by local abstraction of blood. For this purpose I have used for several years a scarificator (Fig. 3.), and cupping-glass (Fig. 4.), which I have described in the N. Y. Med. Journal and also in the Transactions of the N. Y. State Med. Society for 1889.

The most thorough antiseptic precautions should be carried out on the part of the operator and his assistants. The instruments should be thoroughly cleansed. When about to perforate the mastoid process, the parts should be first shaved and cleansed with a solution of bichloride of mercury (1-2000). The incision should be made a quarter

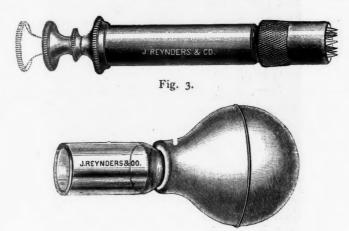


Fig. 4.

of an inch behind the insertion of the auricle, and from one and a half to two inches in length, and even longer when the tissues are swollen. The periosteum should be divided and pushed aside. In cases where a fistula exists it is best to enlarge it by means of a chisel or sharp spoon. When no fistula is found in the bone, no soft spot, it is well to perforate the mastoid about one quarter of an inch below the linea temporalis (i. e., a point slightly below and behind the superior wall of the external auditory canal). Grooved chisels should be used at first and a funnel-shaped opening made, with the apex pointing inwards. The outer table of the bone is usually one fifth of an inch in thickness. The

bone should not be entered to a depth greater than three fourths to five eighths of an inch, so as to avoid injury to the facial canal and external semicircular canal. There is also danger of wounding the lateral sinus and the dura mater in either the posterior or middle fossa, unless we use the chisels in a direction forwards and inwards and take off layer by layer of bone. After penetrating the outer wall of the mastoid, all pus and cheesy matter should be carefully removed, as well as any carious bone and granulations. It is best to enter the antrum in all cases if possible, so as to wash out any cheesy products which are liable to lodge there. We should not fail to investigate the apex, when we do not find pus in the antrum or upper portion of the process. This was the case with one of my patients—viz., case No. 11. Otherwise there is great danger that the pus may burrow down the side of the neck beneath the deep muscles. This happened in case No. 16.

Bezold (in *Deut. Med. Wochen.*, July 9, 1881) describes this rare form of mastoid disease, where perforation occurs on the inner surface of the mastoid in the digastric fossa. Pomeroy, in his "Treatise on the Ear," also mentions it.

After the mastoid cavity has been entirely freed from all pus and débris, it should be thoroughly irrigated with a bichloride solution (1-2000) and where possible, the water should be made to flow from the mastoid out through the antrum and external meatus. A rubber drainage-tube or a silver tube with lateral openings, or a tent of antiseptic gauze, should then be inserted in the cavity. Iodoform should be used in the dressing. After the rest of the wound has been packed with iodoform a bichloride gauze, or several layers of gauze soaked in the bichloride solution, should be applied over the mastoid. Then the whole should be covered with a layer of cotton and bandaged.

In ordinary cases, the patient should be kept in bed several days and allowed a light diet. The dressings should not be disturbed for thirty-six to forty-four hours unless the patient complains of pain or there should be some rise in temperature. In severe cases and where symptoms of septicæ-

mia exist, it is necessary to change the dressings often. In regard to the operation of perforating the mastoid, I quite agree with Rossa who says: "It is after all a plain surgical operation, which no man with any considerable experience in general surgery, need hesitate about, when it is indicated."

# THE IMPROVEMENT IN HEARING OBTAINED BY THE ACTION OF INTENSE SOUNDS IN CASES OF CERUMINAL PLUGS.

By W. KOSEGARTEN, OF KIEL.

Translated by Dr. J. M. MILLS, of New York.

BSERVATIONS in different directions induced me to try whether or not the acuteness of hearing—dulled by disease, as I supposed—could be raised by the action of intense sounds.

The greatest acuteness of hearing was first noted, then a hand-bell rung in front of the ear, and the hearing-distance immediately measured, and later, after from 5 to 15 minutes, the hearing acuteness was measured again.

There were ninety-four cases under observation. tunately, the limited time and press of professional duties prevented me, at times, from recording the result, after syringing (twenty-four cases). However, in nine cases there was positively no improvement in hearing after the syringing; therefore these are not taken into consideration. Of the remaining eighty-five, there was decidedly an improvement in sixty-seven cases after the ringing of the bell; in fiftytwo cases immediately after the ringing; and a few minutes later an improvement was found to be present in sixty-four cases. In three cases the improvement, appearing immediately after the ringing, disappeared in a short time, while in thirty-four cases the improvement immediately obtained increased still more later on. In twelve instances the acuteness of hearing was no better immediately after the ringing, but in a few minutes it increased. Three times the hearingdistance was somewhat diminished immediately after the

ringing, but in a few minutes it rose above the first measurement. This decrease, noticed immediately after the ringing, was most likely due to the deafening produced by the very intense sound.

The amount of improvement varied extraordinarily; at times it was considerable; for example, the hearing-distance increased from 4 to 20, 6 to 29, 1 to 27, 2 to 14, 11 to 70, 4 to 22, 19 to 40, etc.

In ten cases of bilateral occlusion, twice the improvement was about the same in both ears; in two cases it was greater in the better ear; whereas in six instances it was greater in the worse ear. If I am warranted in drawing conclusions from these few observations, then it could be assumed that the better ear had been used more, as ordinary sounds could penetrate into it more easily than into the ear which was more firmly closed.

Upon the whole, my suppositions were confirmed; in by far the majority of the cases the improvement in hearing assumed beforehand was really obtained after the ringing of the bell; and, in fact, several times the improvement was so marked that several colleagues, who were present, were astonished at the experiment. The explanation that the ceruminal plug pressing upon the drum was loosened by the sounds could not be accepted; for it would be exceptional for the plug to be situated so deep in the canal as to press upon the drum-membrane. Another explanation does not occur to me, and consequently the result appears to me to confirm my assumption that the long-continued occlusion diminished the sensitiveness of the nervous acoustic apparatus. I consider that these observations admit of the same explanation ' as that given of the paracusis Willisii by Johannes Müller, who makes the following assertion in his Physiology: "This phenomenon can proceed from a torpor of the auditory nerve, which must be irritated in order to sharpen its activity."

There is only this difference, that in paracusis Willisii the irritation and improvement are simultaneous, whilst in my experiments they are consecutive.

<sup>&</sup>lt;sup>1</sup> Ueber eine künstliche Gehörverbesserung bei grossen Trommelfell-Perforationen.—Habilitationsschrift, 1884.

INVESTIGATIONS IN REGARD TO THE INFLUENCE OF THE FORM OF THE CRANIUM UPON SEVERAL THE IMPORTANT RELATIONS OF **TEMPORAL** BONE.

BY OTTO KÖRNER, OF FRANKFURT-A.-M.

Translated by Dr. J. M. MILLS, New York,

HREE years ago I published in this journal the discovery that the floor of the middle cranial fossa in brachycephali is deeper than in dolichocephali; and that the sigmoid flexure of the transverse sinus in brachycephali penetrates deeper, forwards and outwards, into the mastoid process and into the base of the pyramid of the petrous bone than in dolichocephali.

As I was well aware of the importance of these relations for the operation of opening the antrum of the mastoid, I requested (at the conclusion of my work) all who possessed suitable material to prove the truth of my statements. Until now no additional investigations have been published, but Politzer has criticised my assertions in the following manner: "As a collection of 60 skulls is entirely too small from which to deduce a general rule, therefore more numerous investigations will be necessary to decide the value of these noteworthy communications."

I believe, however, that, to establish the truth of such relations, it depends not so much upon the number of skulls examined as upon their nature. A collection of skulls of various races were placed at my disposal, in which just the extreme dolichocephalic and the extreme brachy-

<sup>&</sup>lt;sup>1</sup> Bd. xii., S. 212 ff.
<sup>2</sup> "Lehrbuch der Ohrenheilkunde," zweite Aufl., 1887, S. 394.

cephalic forms were abundantly represented. Now, naturally, the law is easily discerned in the comparison of extremes, and the inspection of a brachycephalic and a dolichocephalic skull immediately reveals that which would not have been discovered in the comparison of a large number of mesocephalic skulls. It would be very bad indeed for such a law if it could not be deduced from 60 skulls.

But however that may be, since an authority like Politzer has expressed even a cautious doubt, the matter should be investigated again. Another reason influenced me to verify my previous statements. I have shown in the ARCHIVES OF OTOLOGY, that the fatal intracranial diseases, consequent upon caries of the petrous bone (meningitis, sinus phlebitis, cerebral abscess) more frequently occur on the right—that is, after disease of the right petrous bone—than on the left side. The cause of this can only be due to the fact, which is acknowledged by all (H. von Meyer, Hartmann, Bezold, Rüdinger), that the transverse sinus, at its sigmoid flexure, on the right, enters deeper into the mastoid process and into the base of the pyramid of the petrous bone than on the left, and that therefore the sinus on the right, as well as the contiguous dura mater with the neighboring portions of the brain, lie nearer to the primary focus of the disease than on the left. Now, if in brachycephali the transverse sinus—without regard to the greater projection on the right side—is situated altogether farther forward than in dolichocephali, and if also the floor of the middle cranial fossa in brachycephali lies deeperthat is, nearer to the primary focus of the disease—than in dolichocephali, then indeed is the assumption justified, that purulent inflammations of the middle ear and caries of the petrous bone in brachycephali more easily result in fatal intracranial disease than in dolichocephali.

Consequently my statements are not only of value in the performance of the operation, but also in regard to the prognosis of disease of the petrous bone, and the indications for the operative treatment.

<sup>1</sup> Bd. xxvii., S, 126.

As regards the performance of the operation, upon the basis of my former investigations, I have advised that the operation be made far forward; in adults with an index of 1.30, and below, if at all possible, it should be made before the line of insertion of the auricle. Gruber does not consider this proposition practical, because then the remaining bony substance of the posterior wall of the auditory canal will be very thin, which retards recovery. I have never noticed any such injurious result. I always round off with a chisel, any sharp edge of bone left on the posterior wall of the auditory canal in making the operation, just as I completely remove an undermined edge of a wound in the bone. If the operation is made far forwards, then we do not incur the risk of opening the diploëtic space when we remove the edge of bone. Several times, after the antrum had already been opened, I have taken away the posterior wall of the bony auricular canal to a considerable depth, and have obtained a better view into the antrum without increasing the danger. Also in such cases the recovery progressed most satisfactorily, without any subsequent cicatricial deformity of the auditory canal.

For further investigations of my statements twenty-nine skulls from the Senckenberg Society of Naturalists' were placed at my disposal. As before, I only received permission to saw through the sagittal median plane. Also in other respects, the method of examination was the same as before. I therefore refer, concerning these, to my first communication.

The recently examined skulls are as follows:

Index.	Number.	Origin.
1.49	I	From Australia.
1.47	1	From South Sea Islands.
1.41	1	Inhabitants of Fiji Islands.
1.39	1	From New Caledonia.
1.37	2	From Bengal, Sandwich Islands.
1.35	3	Inhabitants of Java, of Sumatra, one of unknown origin.
1.29	. 2	From island of Flores, in East India; negro of unknown origin.

<sup>1 &</sup>quot;Lehrbuch der Ohrenheilkunde," Wien, 1888, S. 524.

Number.	Origin.
3	Bengal, China, one of unknown origin.
1	Malay.
	From Mongolia, one of unknown origin.
4	China, Java, East India, New Zealand.
1	One of unknown origin.
1	Siam.
4	Inhabitants of the Moluccas islands.
	Two of Java, one of unknown origin.
1	Island of Madura, in East Indies.
1	From Mongolia.
	3 1 4 1 1 4

The following Table gives the particulars concerning the position of the middle cranial fossa in these skulls:

INDEX OF THE SKULL.	1.49-1.40	1.39-1.30	1.29-1.20	1.19-1.10
NUMBER OF SKULLS.	3	6	12	8
The floor of the middle cranial fossa lies higher than the external auditory canal. The floor of the middle cranial fossa lies higher than the spina supra meatum.	8	mm 8.33 11 7 12.17 15	mm 5.46 9 3 7.75	mm 5.68 7 4 7.12 9

At my previous examination I obtained the following numbers:

INDEX OF SKULL.	1.55-1.40	1.39-1.30	1.29-1.20	1.19-1.07
NUMBER OF SKULLS.	14	15	19	10
The floor of the middle cranial fossa lies higher than the external auditory canal.	mm 11.15 17	mm 8.8 15 4	mm 5.1 9	mm 4.8 7 2
The floor of the middle cranial fossa lies higher than the spina supra meatum.	15.3 17 10	12.1 17 7	7.6 12 5	5.8 9 4

The result of the examination of this additional though small series of skulls, confirms completely the proposition made upon the basis of my former examinations:

"The floor of the middle cranial fossa in dolichocephalic skulls lies higher over the external auditory canal and over the spina supra meatum than in brachycephalic skulls."

<sup>1</sup> A. a. O., S. 219.

Also the recently found Maxima and Minima agree with those of the first series of skulls. In the extreme cranial forms the number found in the second series of skulls approximate somewhat to the values found in meso-cranial forms, because the very extreme forms are absent in the second series; whilst the indices of the first series extend from 1.55 to 1.07, those of the second series only include the numbers from 1.49 to 1.10. Furthermore, it is very remarkable that in the recent as well as the old measurements, not only the average numbers but also the maxima and minima found with the higher index, are greater than with the lower (index), and that the difference between the maxima and minima, with the higher index, is greater than with the lower one. From this striking accordance of the old and recent measurements, considered even in detail, we can justly conclude that a law is here established, which could have been deduced from a much smaller number of skulls than were placed at my disposal at my first examination. Combining both tables then, we get the following numbers:

INDEX OF THE SKULL.	1.55-1.40	1.39-1.30	1.29-1.20	1.19-1.07
NUMBER OF SKULLS.	17	21	31 .	18
	mm	mm	mm	mm
The floor of the middle ) average	11.3	8.7	5.2	5.2
cranial fossa lies higher than   maximum	17	15	9	7
the external auditory canal. ) minimum	7	4	2	2
The floor of the middle ) average	15.1	12.1	7.6	6.4
cranial fossa lies higher than   maximum	17	17	14	9
the spina supra meatum.   minimum	7	. 7	5	4

I need not repeat what I mentioned before, concerning the position of the sinus transversus in the region of the temporal bone, namely, that the sigmoid flexure of the transverse sinus on the right side—independent of the form of the skull—penetrates deeper into the base of the pyramid of the petrous bone and into the mastoid process than on the left; for that is conceded by every one. I desire, however, to advance another theory, that of H. von Meyer, in addition to the previous one of Bezold and Rüdinger, as it seems just as much justified as the others. It was over-

looked by myself and others. Indeed it seems to me very probable that the facts suggested by Bezold and Rüdinger as well as those by v. Meyer, are the combined cause of the projection of the sinus upon the right side. v. Meyer says: 1

"If we consider only the course of the vessel, then we must regard the innominate vein of the right side as the direct continuation of the jugular vein, the left innominate vein, however, as a direct continuation of the subclavian vein. Furthermore, the superior vena cava as the direct continuation of the right vena innominata, whilst the left innominate vein opens into it on the side. The venous current on the right side, from the base of the skull to the heart, is therefore shorter as well as straighter, whilst the current on the left side is longer by the entire length of the left innominate vein. It is also bent twice at an angle, and therefore strikes against transverse currents into which it has to enter. Consequently the venous stream, on the right side, must not only move much easier, but also the various assisting aspiratory movements will directly influence its circulation. Hence it follows that the longitudinal sinus obtains a much easier exit through the transverse sinus of the right side, and consequently it will become more voluminous."

I further made the assertion that the sigmoid flexure of the transverse sinus on both sides in brachycephali penetrates deeper, forwards and outwards, into the bone than in dolichocephali. Accurately considered, I have only ascertained, by my measurements, that the sinus in brachycephali lies farther outwards than in dolichocephali. The proof that it is also situated farther forwards in brachycephali than in dolichocephali could not be obtained by me, as I was only permitted to make sagittal sections through the skull. However, as inspection has taught me, and already before me Bezold and Hartmann, that the transverse sinus sinks into the bone so much farther forward, as it presses outwardly deeper into the same bone, consequently I can

<sup>&</sup>lt;sup>1</sup> Archiv f. Anat. and Physiol., Anat. Theil, 1887, S. 271. <sup>2</sup> L. c., S. 221.

consider it demonstrated that the transverse sinus in brachycephali is also situated farther forward—that is, penetrates deeper into the bone—than in dolichocephali. The inspection of my skulls also shows that the insertion of the transverse sinus into the bone deeper towards the front is more marked than in the outward direction.

Measurements of the distance of the sigmoid fossa from the auditory canal, in different cranial forms, either directly upon horizontal sections made through the auditory canal, or by means of calipers on frontal section made through the auditory canal, have not yet been made, but are very desirable.

### ON ATRESIA AURIS CONGENITA.

By DR. EUGEN JOËL, OF GÖRBERSDORF, SILESIA.

Translated by Dr. FELIX COHN, New York.

THE results obtained by post-mortem examinations are of such importance in guiding us whether in a given case of atresia auris congenita an operation is feasible or not, that I decided to collect all the recorded cases and publish them together with the case kindly referred to me for examination by Dr. Bezold. I will describe this case at length. The specimen in question is a temporal bone belonging to a female child which died from a right-sided catarrhal pneumonia at the age of a few months.

The temporal bone showed the following abnormities: A rudimentary auricle; tympanic bone missing; tympanic cavity abnormally small; ossicles and mastoid antrum also missing.

The temporal bone was removed in the usual manner, the anterior section cutting the upper part of the cartilaginous portion of the tube in a transverse direction. On the auricle, which was cartilaginous in its upper half only, the helix and lobule alone were distinctly recognizable.

The upper part of the helix is greatly enlarged, and merges directly into the skin, so that only a small, free border remains posteriorly and superiorly, through which a probe can be introduced backward and upward into a blind canal to a distance of five mm. The lobule is of normal size and normally developed, bearing a shallow depression on its

upper part. On the middle of the rudimentary auricle a similar, small, funnel-shaped depression is observable; this depression is bounded anteriorly and posteriorly by small elevations which correspond in all probability to the tragus and antitragus of the normal auricle, while the depression itself likewise corresponds to an external auditory meatus.

The portion of the Eustachian tube that remained in connection with the temporal bone is normal in appearance; the probe can be introduced through the calibre in the direction of the tube up to a distance of 19 mm, at that distance meeting with an osseous obstruction. The tegmen tympani measures but 4 mm, half of the usual width; it is lower, and considerably narrower.

The pyramid, porus acusticus internus, the facial and acoustic nerves, are normal; (at the post-mortem the brain was found to be also perfectly normal). The entrance to the fossa subarcuata is reduced to I mm.

After the tegmen tympani was carefully removed with a chisel, a cancellous osseous tissue was found occupying the space of the tympanic cavity up to a depth of 6 mm. At this distance from the tegmen a small aperture presented itself, corresponding to the distal point, up to which the probe had been introduced through the tube; the head of the probe, however, could not be seen; its presence was only noted by a movable reflex at that point, when the probe was moved up and down in the tube. The probe could also be introduced into a small cavity a little below the above-mentioned aperture.

The mastoid process was only very slightly developed; a little anteriorly to the same, a small, irregular quadrilateral plate of bone was found; it was slightly movable and joined in its thicker portion to the squamous portion of the temporal bone; the place of union had not yet been ossified. Its upper surface was horizontal, the lower slightly concave and saddle-shaped. Below this plate a little aperture was visible; from the anterior border of the aperture a cartilaginous mass, 9 mm in length, and 2 mm in width, was attached to the lower surface of the above-mentioned bone; it served as an articulation for the lower maxilla.

## Description of the Temporal Bone after Maceration.

The temporal bone separated into two parts: into the temporal bone proper, the larger portion, and into the small quadrilateral plate already described at length. Of the temporal bone the outer surface is perfectly normal and corresponds in almost every detail to a normal temporal bone. Its mastoid portion merges directly into the squamous portion and into the posterior wall of the auditory canal. The latter forms a furrow with its concavity directed forward and backward. At the junction of the mastoid portion with this auditory furrow a small irregular aperture is visible. In its anterior portion this auditory furrow is covered from above by a trilateral delicate plate of bone, which does not, however, unite with the lower border of the furrow, leaving therefore a fissure which communicates directly with the canal for the tensor tympani and with the adjoining orifice of the Eustachian tube.

The outer wall of the osseous portion of the Eustachian tube is entirely wanting; the tube, being bounded superiorly by a small piece of bone projecting from the tegmen tympani, anteriorly by the wall of the pyramid, and inferiorly by a small horizontal, curved plate of bone projecting from the lower wall of the anterior pyramid.

No sign of the formation of a tympanic bone is found either on the auditory canal or on the tube.

The upper part of the tympanum which is generally traversed by the malleus and incus is entirely missing. The antrum is replaced by a small fissure extending from the tympanic cavity for a short distance immediately behind the narrowed border of the auditory furrow. The tympanum itself is much larger and its internal wall almost normal in appearance. The fenestra ovalis is reduced to about \(\frac{1}{3}\) of its natural size. A narrow plate of bone, directed backward, and slightly outward, and gradually forming a furrow with its concavity directed upwards, projects from the promontory towards the outer wall, and is terminated by a small opening corresponding probably to the small aperture which transmits the tendon of the stapedius muscle. Slightly posteriorly and below this small plate of bone, we find the aperture of the fenestra rotunda.

The tympanum runs directly into the canal formed by the osseous portion of the tube. This canal is abnormally wide. The plate of bone which usually separates the semicanalis pro tensore tympani from the tube is missing. Its continuation as well as the processus cochleariformis are also missing. No ossicles were found; whether the stapes was also absent could not be ascertained; it is possible that a small rudiment of bone corresponding in size to the reduced fenestra ovalis might have been present, and have been lost during the process of maceration. Malleus and incus were surely missing, nor could those ossicles have had room in the fissure which was found to replace the normal aditus ad antrum.

The small quadrilateral piece of bone, which has already been described, deserves our especial attention; it was not found in any of the cases already published. As regards form and position it bears the closest resemblance to a bone found by Albrecht in the skull of a new-born child and designated by him as the "os quadratum," a bone commonly found among the lower vertebrates. This bone is considered by the above author to be an equivalent of the inferior part of the squamous portion of the temporal bone, its anatomical function being chiefly the formation of the articulation for the lower maxilla. Gegenbaur, Kölliker, Wiedersheim, and Heuren do not maintain this view, but consider the os quadratum of the lower animals as an equivalent of the incus. The study of our own specimen inclines us to the views of Albrecht with regard to the morphological value of this bone.

I have found only eleven carefully recorded cases of congenital closure, and for the sake of comprehensiveness will here put them together in tabular arrangement with the bibliography subjoined.

<sup>&</sup>lt;sup>1</sup> Über den morphologischen Werth des Unterkiefergelenkes, der Gehörknöchelchen und des mittleren und ausseren Ohres der Säugethiere. By Prof. Dr. Albrecht of Brussels. Basle, 1885.

Grundzüge der vergleichenden Anatomie." Leipzig, 1870, p. 662.
 Entwickelungsgeschichte des Menschen," p. 486.
 Lehrbuch der vergleichenden Anatomie der Wirbelthiere." Jena, 1882, p.

<sup>155. &</sup>quot;Hermann's Handbuch der Physiologie," vol. iii., part second, p. 22.

Author. Age. Auricle. Portion  Auticle. Tympanum. Ossicles. Tube. Labyrinth. Power. Canal.  Bezold. <sup>1</sup>						Condition of	Jo			
smaller. missing. present. normal.  {	+	Age.	Auricle.	Osseous Portion of Auditory Canal.	Auricle.	Tympanum.	Ossicles.	Tube.	Labyrinth.	Hearing Power.
rudimentary.  missing.  very small.  rudimentary.  rudimentary.  rudimentary.  present.  rudimentary.  present.  rudimentary.  missing.  marked.  marked.  marked.  rudimentary.  marked.  marked.  rudimentary.  marked.  rudimentary.  marked.  marked.  rudimentary.  marked.  rudimentary.  marked.  rudimentary.  marked.  marked.  rudimentary.  marked.  marked.  rudimentary.  marked.  rudimentary.  marked.  rudimentary.  marked.  rudimentary.  masing.  marked.  rudimentary.  marked.  rudimentary.  marked.  rudimentary.  mormal.  rudimentary.  mormal.  rudimentary.  mormal.  rudimentary.  mormal.  rudimentary.  mormal.  rudimentary.  mormal.  rudimentary.  rudimentary.	se).	8 months.	malformed.	missing.	missing.	smaller.	missing.	present.	normal.	1 1
missing rudimentary. present. present. very small. present. very large defective. very small. missing. present.  very small. missing. present.  present.  yery wide normal. missing. present. present.  present. present.  present. pre		47 yrs.	:	:	1	rudimentary.	missing.	slightly marked.	defective.	deaf.
very small.  rudimentary.  present.  very large.  very large.  very large.  very large.  very small.  present.    malformed.   normal.   normal.		still-born.	" rudimentary.		missing.	missing.	::	rudimentary.	missing. normal.	11
present. defective. very wide. not com- very large. "  very large. "  insising.   malformed.    present.   fonly partly    resent.   fonly partly    resent.   folly partly    resent.   folly partly    resent.   folly partly    resent.   folly partly    resent.   followenheilk., vol. x., p. 15.		65 yrs.	malformed.	~	missing		defective.	present.	: :	deaf.
very large.  very small. missing. present. present.    Anot com-   pletely   normal.   malformed.   present.     cony partly     Tstschr. f. Ohrenheilk., vol. x., p. 15.   s Ztschr. f. Ohrenheilk., vol. x., p. 179.		63 yrs.	:	marked. y	1		defective.	very wide.	3	deaf.
very small. malformed. normal. normal. present.   normal.   normal.		under 25 yrs.	ı	slightly   marked.	l	very large.	2	1	not com-   pletely	1
present. { only partly }  7 Ztschr. f. Ohrenheilk., vol. x., p. 15.  8 Ztschr. f. Ohrenheilk., vol. x., p. 179.		60 yrs.	malformed.	missing.	missing	very small.	malformed.	normal.	normal.	deaf.
		about 25 yrs.	:	slightly }		present.	{ only partly } normal.	1	:	1
	cobson, in double-si	the Archi	v für Ohr., vital closure, i	ol. xix., desen which only	cribes a	Tztschr. 8 Ztschr.	f. Ohrenheilk f. Ohrenheilk	', vol. x., p		. 15. 0. 179.
	xxix., p. 07. 3 Virchow's A	"., p. o7. Virchow's Arch., vol. xxix., p. ( Virch. Arch., vol. xxx., p. 229. Virch. Arch., vol. xxx., p. 229.	iix., p. 07.  * Virchow's Arch., vol. xxix., p. 62.  * Virch. Arch., vol. xxx., p. 229.  * Virch. Arch., vol. xxxii, p. 510.			genie," 1883. <sup>12</sup> Sitzungsl A case is al	Genach S Bentrage zur Morphologie und Morphologenie," 1883.  12 Sitzungsber., d. Münchener Morphol. Ges., 1885, p. 130.  A case is also described by Gruber in his "Lehrb. d.	chener Morp	hol. Ges., 188	Morpho 5, p. 130 ehrb. d

A study of this table shows us, in the first place; that the different parts of the organ of hearing do not participate equally in the process of malformation; secondly, although a great similarity exists between most of the cases, there are not even two which present exactly the same pathological condition.

Let us now enter more closely upon the study of the different malformations that were observed: We find, first of all, without any exception, some imperfections in the formation of the auricle, either with regard to its anatomical relations, or in presenting only a slight variation from the normal, or, as in some cases, presenting a complete rudimentary formation. In most cases the rudimentary auricle shows traces of an auditory aperture in the shape of a shallow depression; in some of the recorded cases, however, not even a trace of the formation of a meatus could be found.

In a few specimens the cartilaginous portion of the auditory canal was present, always, however, forming a pouch by being closed at its tympanic end.

The osseous portion of the auditory canal presented a similar condition in almost all the specimens; a mass of compact or cancellous osseous tissue generally took the place of the normal canal; occasionally a small defect in the bone could be observed; in some specimens even a narrow fissure would lead into the tympanum, but in none of the cases was a real auditory canal present.

As the tympanic bone was missing on all the specimens, of course no membrana tympani could have been found; the absence of the tympanic bone therefore fully explains why no membrana tympani was found in the specimens taken from adults.

The tympanum was narrowed by bone tissue in most of the cases; in a few, however, the whole tympanum was replaced by a mass of osseous tissue.

The ossicles presented the greatest variation from the normal. They were either entirely missing, or only some of their processes were wanting; frequently the articulations were ossified. In this connection it is of great importance to note the fact, that not only the malleus and incus—products of the first branchial arch—were found to be abnormally developed, but that the stapes also, a

product, according to Kölliker, of the second arch, was never found normal. The latter showed variations either in regard to shape: sometimes only one branch was present, or there was some change in its base, or in the articulation connecting it with the fenestra ovalis. The Eustachian tube was found normal in a few cases; in other specimens some slight irregularities were present; very frequently the place of communication between the tympanum and the tube was missing.

The labyrinth was rarely affected; variations were found in two specimens only.

It is evident, from the facts here stated, that congenital closure of the external auditory canal is always accompanied by changes in the other parts of the organ of hearing, and changes generally in parts which are contiguous or adjoining. If we study more closely the variations which have been observed, we find that they show a great resemblance to the pathological changes that occur during disease. We find, for instance, stenosis of the external auditory canal, frequently accompanying inflammatory conditions of the surrounding parts. The tympanum also is very often obstructed by hyperplastic connective tissue; the ossicles are frequently rendered immovable by the same inflammatory process, and very frequently they are even completely, or at least in part, destroyed by caries. And one of the most frequent causes, also, of a very high degree of deafness is the fixation of the stapes to the fenestra ovalis. This latter condition has frequently been found present among the specimens of congenital closure.

If we consider furthermore that the fœtal tissues are very frail in comparison with the completely developed organs, we can surely attribute the great changes which we have found in the above tabulated cases to inflammatory conditions during embryonic life. As an organ cannot very well develop normally when such embryonic inflammatory processes are going on, we necessarily obtain deformities and pathological changes, which are due partly to arrest of development, and partly also to the intra-uterine inflammation itself.

It is of importance to the practitioner to determine whether the arrest of development is confined only to the external portion of the ear, or whether the whole organ of hearing has been affected. Formerly an operation, the formation of an artificial canal, was advised in case of congenital closure; I believe that a study of the cases here recorded must show that any operation whatever must be entirely useless. The case of Bonnafont is the only one recorded in which a distinct and lasting improvement was obtained by surgical means. In his case, however, there was no real osseous stenosis of the auditory canal at all, only a dense membrane in front of the membrana tympani.

It is perfectly clear, therefore, that any operation must be useless in those cases where we find an osseous mass in

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place of the auditory canal.

Besides the difficulty of maintaining an artificial opening for any length of time, we cannot conceive that organs of hearing could perform their functions properly with such changes in the middle ear and in the labyrinth as have been here described.

The cases of malformation which show externally a rudimentary auricle and an atresia of the auditory canal, should be an absolute *noli me tangere* for the surgeon. Nature herself has placed her limits in these cases.

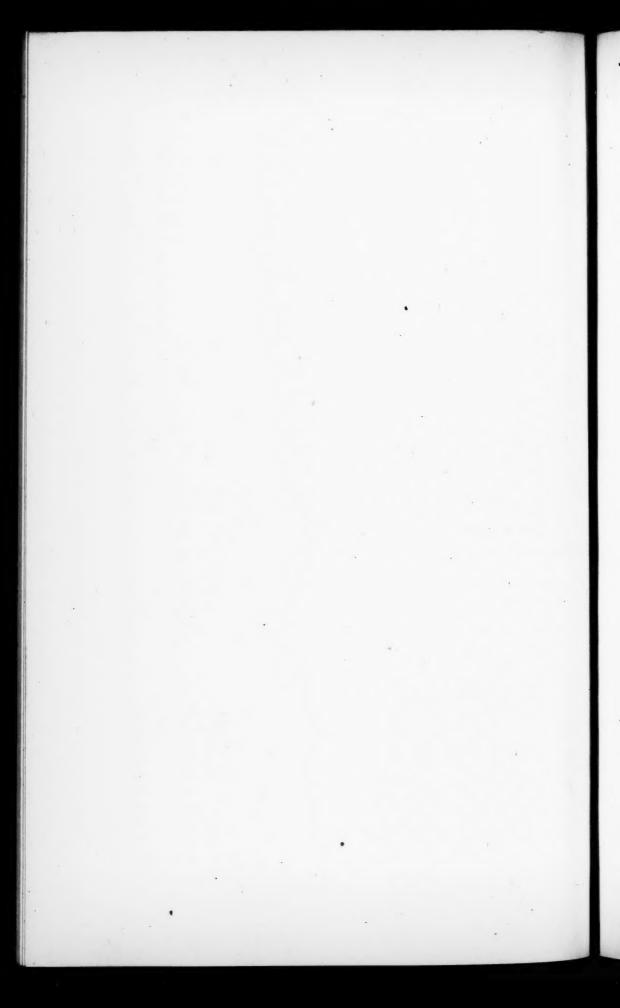
I take this occasion to thank my honored teacher, Prof. Bezold, for his kind assistance in the preparation of this paper.

### MISCELLANEOUS NOTES.

The Grand Duke of Baden has distinguished the German coeditor of these Archives, Prof. S. Moos, by conferring on him the title of "Hofrath" (aulic counsellor).

Prof. Voltolini, of Breslau, Germany, died, at the age of 70 years, Sept. 10, 1889. His great and successful activity for the advance of the departments which he cultivated, is universally known. He was one of the few who, in study, practice, and teaching, embraced the branches of otology, laryngology, and rhinology, which, at present, are mostly separated. Even in the last years his method of illuminating the larynx and other cavities by transmitted light has produced a great sensation and has been extensively discussed.—Berl. klin. Woch.

Editorial Note.—It is intended in future to issue the numbers of these Archives in January, April, July, and October.



## INDEX TO VOLUME XVIII.

Adenoid Vegetations, 214
Albuminuria, Deafness in, 192
Anatomy, Reports of Progress in, 183
Atresia, Congenital, of Ear, 317
Auditory Nerve, Galvanism of, 188, 205
Auditory Reflexes, 274
Auditory Vertigo, 206; Excision of *Mt* in, 207

BACON, Mastoid Disease, 230
BARR, Purulent Disease of Ear Invading Cranial Cavity, 115
Basedow's Disease and Nasal Disease, 211
BERGMANN, Surgery of the Brain, 101
BLOCH, Nasal Respiration, 1
Brain, Surgery of, 101, 202
BUCK, Manual of Diseases of the Ear, 112
Bursa Pharyngea, 214

Cerebellum, Successful Operation on Abscess of, 217 Cholesteatomata, 184 CLARK, C. F., Loss of Membrane and Ossicles with Good Hearing, 219 Cranium, Influence of Form of, on Temporal Bone, 310 Creolin in Ear Diseases, 191

Ear, Anatomy of, 186; Physiology of, 187; Technique of Dissecting the human, 215

FERRER, Diseases of the Mastoid Process, 25, 139
FERRERI, Diseases of the Nose, 216
FINLAYSON, Purulent Disease of Middle Ear Invading Cranial Cavity, 115

Foreign Bodies in Ear, 194 Furuncles, Boric-Alcohol Treatment of, 194

Headache and Tubal Obstruction, 211
Hearing, Improvement of, by the Action of Intense Sounds, 308
Highmore's Antrum, Empyæma of,
210; Operations, etc., 210

Instruments and Means of Examination, 192

JOACHIM, Physiology of Soft Palate, 226 JOEL, Atresia Auris Congenita, 317

KOERNER, Influence of Form of Cranium on Temporal Bone, 310
KOSEGARTEN, Improvement of Hearing by the Action of Intense Sound, 308

Labyrinth, Bacterial Invasion of, during the Measles, 49 Lactic-Acid Treatment, 200 Leprosy of Ear, 191 MACEWEN, Successful Operation on a Cerebellar Abscess, 217

Mastoid Abscess without Perforation of the Mt, 202

Mastoid Disease, Cases of, 25, 139, 280

Mastoid, Primary Inflammation of,

Maxillary Sinus, Anomaly of, 186 Measles, Bacteria in Labyrinth during the, 49, 190

Membrana Tympani, A Case of False, 195: Functions of, 189; Loss of, and Ossicles with Good Hearing,

Ménière's Disease, 206

Meningitis from Purulent Invasion of Cranial Cavity, 115

Miscellaneous Notes, 113, 215

Moos, Bacterial Invasion of the Labyrinth during Measles, 49

Nasal Polypi, 213 Nasal Respiration, I Nasal Sounds, Physiology of, 188 Naso-Pharyngeal Disease and Uterine

Disturbance, 211 Naso-Pharynx, Anatomy of, 186 Necrosis, Acid Treatment in, of Tem-

poral Bone, 123

Negro, Ear of the, 192 Nervous Apparatus, Therapeutics of, 205

Nose and Naso-Pharynx, Therapeutics of, 208

Nose, Bacteria of the Normal, 209; Diseases of the, 216; Diseases of, and in Ear, 204

Nystagmus during Otitis Media, 199

OLE BULL, Acid Treatment of Temporal Necrosis, 123

Ossicles, Loss of, and Good Hearing, 219; as Transmitters of Sound, 205 Othæmatomata in Foot-Ball Players, 194 Otitis Media, Bacteriology of, 184; from Inflation, 198; Tympanica, 201

Otitis Purulenta and Metastatic Irido-Choroiditis, 199

Otitis Suppurativa, Bacteriology, 198 Otomycosis, Botanical and Clinical Contributions to, 235

Pachymeningitis Externa after Aural Disease, 201

Pathology and Therapeutics, Report of, 189

Physiology and Physics, Reports on, 187

POLITZER, Dissection of the Ear, 215 Polypus, Treatment of, 199; Cause of Epilepsy, 200

Reports of Progress, 183 Reviews, 101, 215 Rhino-scleroma, 213

Semicircular Canals, Physiology of 187 Septum, Abscess of Nasal, 211

SEXTON, The Ear and Its Diseases,

SIEBENMANN, Contributions to Otomycosis, 235

Smell, Intensity of, 189
Snare for Polypus, 193
Soft Palate, Physiology of, 226
Sphenoid Bone, Physiology of, 188
STEINBRUEGGE, Auditory Reflexes,

274 Syphilis of Ear, 194; of Nose, 211

Techniphone, 193

Temporal Bone, Influenced by Form of Cranium, 310

Tinnitus from Sphenoid Vibration, 187; Nitro-Glycerine in, 204 Tympanum, Projectiles in the, 203

